Smithsonian Institute

VOL. VIII. SEPTEMBER, 1884. No. 5.

THE KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY.

EDITED BY

THEO. S. CASE.

LIBRARY OF CONGRESS OCT 10 1884 SMITHSONIAN DEPOSIT

TABLE OF CONTENTS.

PAGE.

PHYSICS.

1. The Forces of Inorganic Nature.* Rev. James W. Hanna 225
2. Selenium and Its Uses. 234

ARCHÆOLOGY.

1. Did the Romans Colonize America? 236
2. Death of Black-Bird.* A. R. Fulton. 243

ENGINEERING.

1. The Paris Wood Pavements 245
2. Relative Right of Railroad Companies and the Public. 247
3. Creators of the Age of Steel 251
4. The Isthmus Canal 260

EDUCATION.

1. School and State.* C. W. Stevenson. 261
2. The Text-Book as an Element in Science Teaching.* Prof. Gilbert B. Morrison. 270

CORRESPONDENCE.

1. Mining Outlook in Colorado for 1884.* John K. Hallowell 274

PAGE.

METEOROLOGY.

1. 'Kansas Weather Service.* Prof. J.T Lovewell 276
2. Direct and Indirect Barometric Waves.* C. A. Shaw 277

BOOK NOTICES.*

1. Life of Liszt. Jansen, McClurg & Co 278
2. The Transactions of the Academy of Science of St. Louis, vol. IV, No. 3. R. P. Studley & Co 279
3. Ninth Annual Report of the Railroad Commissioners of the State of Missouri, 1883 279
4. Politics. G. P. Putnam's Sons . . 280
5. What is to be Done. Lee & Shepard 280
6. Other Publications Received 280

SCIENTIFIC MISCELLANY.

1. Recently Patented Improvements.* J. C. Higdon, M. E 281
2. Lost Arts in the Patent Office.* W. R. Kirk 283
3. The Twilight of Roman Sculpture. W. S. Liscomb 285

EDITORIAL NOTES 286

* Written for the REVIEW.

Entered at the Post Office at Kansas City, Mo., as second class matter.

Subscription Price, $2.50 per Annum, post-paid; Single Numbers, 25 Cents.

For Sale by the AMERICAN NEWS COMPANY, 39 and 41 Chambers Street, N. Y.

KANSAS CITY, MO.
PRESS OF RAMSEY, MILLETT & HUDSON.

ESTABLISHED 1858.

Kansas City, Sept. 1st, '84.

L. Hammerslough & Co.,

The One-Price Clothiers,

Present compliments to the readers of the **Review,** *and beg to call their attention to our unrivaled stock of* **Gentlemen's and Youths' Clothing and Furnishing Goods.**

We sell none but the Best Articles. Our prices are plainly marked in figures and are never deviated from.

It is useless to specify, as **we have everything that a Gentleman can want** *to make himself comfortable and attractive in appearance.*

We make WEDDING SUITS a specialty, and can supply the finest grades on very short notice. CLERGYMEN are always allowed a discount of 10 per cent.

When you are in Kansas City, please call and examine our Goods. **We know that we can suit you,** *both in quality and price.*

Yours, L. HAMMERSLOUGH & CO.,
Cor. 5th and Main Sts.

Established 1865.

ED. H. WEBSTER,

Real Estate AND Loan Broker

FARMS, Unimproved and Mineral Lands Bought and Sold, Capital Invested, Rents Collected, Taxes Paid Titles Examined, Deeds, Leases and General Conveyancing and Notarial Business promptly attended to.

Office, No. 603 Main Street,

KANSAS CITY - MISSOURI.

JOHN H. KRULL,

MERCHANT TAILOR,

106 and 108 West 5th Street.

A Large Assortment of Foreign and Domestic Woolens.

First-Class Fit and Workmanship Guaranteed.

KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. VIII. SEPTEMBER, 1884. NO. 5.

PHYSICS.

THE FORCES OF INORGANIC NATURE—SOME NEW PHILOSOPHY.

REV. JAMES W. HANNA.

Some years ago the writer left college armed with a bundle of diplomas, pleased especially with what he knew of science. With Espy's theory of meteorology in his cranium, he began making observations for himself. The result was that he soon discarded most that passed for science in meteorology. He concluded also that the causes of heat and cold were but partly understood. Frosts in June and thaws in January were caused by something that our philosophy knew little of. Indian Summer next became a study,—then the nature of heat, and the forces of organic and inorganic nature. The method was to study well the books, but to get behind the books, and ask Nature if certain things were so. An assortment was made of things established, and of things assumed; plausible theories were scrutinized, and the iconoclastic spirit was allowed full play. The result was I became a scientific doubter. Or, rather, a doubter of much of the theories of the scientists. I will not shock the reader by a full disclosure here. And in this article I will as much as possible avoid antagonizing him. My debate against old theories, which would make quite a chapter, may lie with the rubbish. This article is devoted to bringing in some of the new.

The first great point reached, and which after careful study, was fixed and became a rallying point was this: *All the attractive forces of inorganic nature are one.* That is to say, gravitation, cohesion, adhesion, capillary attraction, chemical affinity,

electrical attraction, magnetic attraction, contraction of solids, liquids and gases, all these are simply manifestations of the same force under different conditions. These are names by which we designate phenomena, or the causes of phenomena, the names of forces, as force manifests itself in its tendency to bring things together, and hold them together. We have not space here for the argument by which the above conclusion is reached. The realm of physics abounds with data which, when properly considered, make the conclusion irresistible. It is all clear sailing with not a breaker in the pathway. Accepting the above as established, the question arises: What causes this force? What is its origin?

As we wait to learn, we reach another conclusion. There is in nature another force, *repulsion*. A force equal in operation, equal in importance with attraction. It is as everywhere present, it operates in as many varied conditions, it is scarcely less powerful. These two forces are correlated. They pertain to opposite conditions; what gives strength to the one, gives apparent weakness to the other. They never destroy but in all cases they act against each other. Repulsion is seen in the expansion of gases, in the expansion of metals, in electrical repulsion, in the repellent power of heat in all its manifestations. In the Sun there is a repellent power co-ordinate with the attractive power. This drives volatile matter from the comets, thus making their tails; this causes the diurnal revolution of the planets. This gives to the several planets their several distances from the Sun. Thus all along the line, from the highest manifestation in the heavens to the minutest exhibitions of earth, we have these two forces side by side; the one as much a factor in the world of phenomena as the other. Accepting this also as established, the question arises: What causes this force? What is its origin?

As heat expands gases and metals, as it makes solids liquid, and makes liquids vapor, as it overcomes chemical affinities, as it dissipates magnetic power, changes electrical conditions, and seems to be the great repellent factor in the solar system, we cannot but inquire into the nature of heat, and ask, is it a factor in gravitation? Does it play a part here as it does in all other conditions of the attractive force?

We are inclined to give this query an affirmative answer. But an affirmative answer here requires an abandonment of the current theory of heat. For all scientists are teaching us that heat is but a mode of motion. We are being led to look at it as something real—and the most potent of all the realities in nature. A survey of organic nature and its forces, the forces by which living bodies are builded, and the surrender made in their dissolution, tended the more to confirm this view and to demand a new hearing of the whole question as to the nature of heat.

As this investigation was made about nine years ago, I am not sure that I can follow the lines of inquiry as they were followed then, but an important question was, whence the heat of friction? The conclusion reached was that it is from electricity. Some of the reasons for this conclusion will appear as we advance.

At this point I reviewed the discussion of physicists on the nature of heat. The old emission theory, though crude, and in some respects faulty, was, I thought, too readily abandoned. Count Rumford's cannon-boring experiment had undue influence. While it covered a very little, it was allowed to determine a great deal. It showed that the heat that came from the friction in boring did not come out of the iron chips, or in any way deprive them of former capacity as to heat. But did it prove anything more? It simply established a negation; a negation of narrow limits. And yet it is paraded as having cleared the way for an entire new departure; and as conclusive against what had been the received theory. If heat is a constituent of electricity, if electricity pervaded and enshrouded the cannon that was being bored, and every part of the machinery used in the boring, and if it is possible under certain conditions to have electricity surrender its heat, we may claim Count Rumford's experiment as confirming the theory here advanced. His experiment suits no man's theory, or purpose, better than mine.

I followed on through all the recorded experiments, and they all seemed to illustrate and confirm my position.

Convinced that the heat of friction is from electricity, and that heat is not motion, but that it is an entity, a substance, I found it in harmony with true philosophy to speak of immaterial substances. A substance is that which underlies attributes, or manifestations. Any being with relations so discerned as to distinguish it from other beings is a substance. Throughout the centuries it has been agreed among the learned, that there are corporeal substances and also spiritual substances. The best intellects of the world to-day recognize both of these. Finding that there was nothing absurd in the idea of an immaterial substance, I was ready to place heat under this category. Are there then in nature substances corporeal, and substances incorporeal? Under the first do we have matter, and under the second heat?

Allowing this as a hypothesis, we determine farther, that the one substance, matter, is inert, powerless, destitute of all known properties. The other substance, heat, is active. It is self-repellent, and this self-repellence is one of the mighty forces of nature. From this self-repellence comes repulsion in all its forms. These two substances have an affinity for each other, and this is the other of the mighty forces of nature. In this affinity, attraction in all its forms, and in all its degrees, has its origin. Repulsion is co-extensive with attraction, and these two are so related that they are ever in conflict, the one tending to bring things together and to keep them together; the other tending to put them apart and keep them apart. The above are both imperishable forces; constant forces, always the same when conditions are the same; their manifestations changing as the conditions change, so that the direct of the one is the reverse of the other.

If the above propositions are established, we have in them the key that unlocks all the mysteries, and explains all the phenomena in connection with inorganic nature. Here we learn what gravitation is, what its origin, and we get more correct knowledge of its laws.

With these propositions before us, let us look at nature and see if we are justified in accepting them.

From the densest of metals to the rarest of gases there is a law of contraction and expansion. All bodies are expanded by the application of heat. Here we have the repellent. They are all contracted on its withdrawal. They all have a capacity for heat. Each after its own measure absorbs heat without increase of temperature. They may all be vaporized, or thrown into gaseous form. But in this change an immense amount of heat affiliates with the atoms of matter. And in this condition they fill many times the space formerly occupied. Here we have both the affiliation of heat with the matter, and the expansive power of heat in separating the matter. The more the heat is applied, the more room is demanded; the expansive force, the self-repellent force, bursting the confines and filling vast regions of space. This is found everywhere in nature. The binding force that binds substances together is under law, each substance having a measure of its own. Each having a law of its own with regard to the rise of temperature, each a law of its own as to the amount of heat it appropriates without rise of temperature, and a law of its own as to the amount of heat required to accomplish certain results. But in all cases heat is king. It unlocks every barrier. It determines every new condition. It dissipates into the realms of the invisible, masses of matter, by enshrouding itself in gauzy garments too attenuated for observation. In the taking up of these particles of matter we see the affinity between heat and matter. In the carrying of them away we see the repellent power of heat. Were it not for the attraction that causes the atmosphere to press as an ocean on the surface of the earth, this self-repellence would dissipate it through all space. In everything we have these two elements, heat and matter, differently compounded. In metals we have most matter and least heat. In liquids less matter and more heat. In gases we have least matter and most heat. And metals are more or less refractory, liquids more or less volatile, and gases more or less attenuated, in proportion as the one element or the other, heat or matter, predominates in its composition.

Wherever you touch the science of chemistry you find these positions illustrated and confirmed. Here every gas, simple or compound, has its appropriate measure of heat. Two simple gases have more heat than their compound requires—so in their union heat is given off. All chemical changes are accompanied by corresponding changes of heat. Our theory would require this. Chemical combinations produce heat, because here the more attenuated resolve themselves into the more compact, and heat is set free. Chemical decomposition causes a disappearance of heat, because here the one compact substance is resolved into two that are more volatile, heat being the element that is necessary to the new condition. We have this law, the combination of any two bodies chemically, is attended by the evolution of a quantity of heat equal to that which disappears in their separation.

Most chemical changes are complex. In them we have both decompositions and recompositions. Here both the *minus* and the *plus* come in, so we have this

great law, that in all combinations effected through the simultaneous decomposition of compound substances, the heat evolved in the case is equal to the difference between these *plus* and *minus* quantities. It is the *resultant* of that which is given off by the combinations, and that which is appropriated in the decompositions.

Let us not forget, that in all these chemical changes, heat is as much a factor, as measurable a factor, and a factor as definite in its operations, as any other element known in chemistry. Yes more, every law in chemistry results more from it than from any other element.

In combustion we have dissolutions and chemical combinations. Ordinarily oxygen combines with the matter said to be consumed. The oxygen going into the new combination surrenders a portion of its heat. Hence the heat of combustion. And in perfect accord with our theory, we have this rule, that in ordinary cases the heat of combustion is proportionate to the amount of oxygen required in the burning. If the combustion is of two gases, as oxygen and hydrogen, they both surrender portions of their heat. Hence the intense heat in the case. The heat of combustion is of like origin with the heat in other cases of chemical recomposition. Here the same law prevails. The difference is in this alone, that the conditions here are such as to produce luminosity. The reader will see how perfectly all this harmonizes with the theory here advanced.

Again, as all solid substances can be vaporized, or decomposed and their elements thrown into gaseous form, as this can only be done by means of heat, and as in every case, in the process, a definite amount of heat becomes latent, these gases may be regarded as composed of matter and heat. We have the heavier gases, and the lighter. We know that the heavier gases contain more matter, and the lighter gases less. The lightest gas known to us, hydrogen, is fourteen and a half times lighter than the air, yet it contains matter, being one of the constituents of water.

Beyond hydrogen our observations are limited. The substances that lie beyond are too subtle for us. Yet there are, doubtless, lying in this region subtle gases unknown to us. Beyond all, and crowning all, we have the rays that come to us from the Sun. By the solar spectrum these are divided into heat-rays, color-rays, and chemical-rays. Analogical reasoning may lead us to suppose that these chemical-rays are composed of matter and heat. For not only do they behave like other chemical elements, but, like the gases, they can be made to yield their heat, latent heat, to yield it in great quantity. So electricity lying somewhere, as a half-way point between hydrogen and the chemical-rays, is composed of heat and matter, the heat latent till disengaged. Returning to the spectrum, passing on beyond the chemical-rays, and the color-rays, we have the heat-rays: the heat here being more intense. In the color portion of the spectrum the red is hotter than the yellow, the yellow hotter than the green, the green hotter than the blue, the blue hotter than the violet, and the violet hotter than the chemical-rays. These color-rays, like the chemical, can be thrown into heat. Then in the color-rays also, there is *latent heat.* Now if the analogy holds good,

every colored ray has in it a degree of matter. Least in the red, more in the yellow, still more in the green, next in the violet, and then most of all in the chemical-rays. And so you may go on, through electricity and through the gases. And here is the basis for Delong's and Pettit's law of specific heat. The relative quantities of heat and of matter entering into the composition of gases is the very principle that this law takes cognizance of. The bearing of all this on the question, and its beautiful harmony with my whole theory will be at once perceived.

Now about electricity. Electricity is a gas which we cannot handle in the gas form. But so strong is the affinity of some gases for matter, that they mass themselves on the surface of bodies. For example, a bar of platinum becomes covered with a blanket of oxygen. It may be wiped off, it may be driven off with heat, it may be coaxed off by putting the end of the bar in a chemical mixture for which oxygen has a strong affinity. There is a law about this massing. Only a heavy metal can master and bind a heavy gas. Platinum sponge has a great capacity for condensing hydrogen, and observe, in the condensation, heat is given off, so that a hydrogen gas-jet lights itself, by heating the platinum sponge against which the gas strikes. A small lump of charcoal will condense within itself more hydrogen than will fill an ordinary room when free. From this condensation of gases we sometimes have the heat that causes spontaneous combustion. All these things confirm my theories; but I mention them here to help us understand electricity. Electricity is the most abundant of all gases. It is in all the air, and in the regions above the air. Its affinities are such that it can be massed by almost anything. There is a blanket of it around almost everything you touch. It is held in every degree of mobility or rigidity, according to the nature of the body to which it adheres. The degree of attractive force in each case determines the texture of the coating, and from this we have the scale, from good conductors to good insulators. And from this also grows that other scale, from bodies most highly positive to lowest negative. Electricity is not only on the surface of bodies, but it enters the pores and pervades all bodies. Sound is conducted by it, and the rapidity of the conduction of sound in different bodies, the distance to which the sound will be carried, and the loudness of the sound, all depend, other things being equal, on the different electrical conditions of the bodies through which the sound is transmitted. There is no reason why, with the proper use of electricity the telephone, like the telegraph, may not convey its messages around the world.

Electricity in the gas form is next of kin to heat. And see its affinity for matter. And see also its self-repellence when free. Like the other gases, yet exceeding them all, in the strength of attraction, and in the force of the repulsion. I see no necessity for two kinds of electricity. We give the name electricity to the subtle gas or gases found massed upon solids. In the attraction that masses them we see their affinity for matter. We see this also in the experiment of the pith balls. If one be charged, and the other not, there is attraction, because of this affinity. If there be contact, there is equilibrium, as concerns the balls; but

as both are now slightly charged, there will be slight repulsion. Charge both balls to their full capacity, and we have strong repulsion, because now the repellent element is in excess on both. Here, as all along, we find the heat element self-repellent. We have the clearest proof that attraction results from the affinity between the two elements. In attraction, we may be allowed to assume that the potency is in the heat.

Now let us for a moment look at the question: Is the heat of friction from electricity? This question should now require but a short argument. Observe, it would have been impossible to have insulated Count Rumford's cannon. And the heating of that water was a small affair, when we consider the nature of electricity. It will be found that friction between bodies that hold electricity with a degree of rigidity will develop most heat. And it will be found that every lubricator is something for which electricity has the least possible affinity. Glass is coated with electricity, and water is charged with it. So when Prof. Tyndall pours water, or mercury, from glass to glass, and tells us the *motion* makes heat, we may object. So again, not only his bullet, but his anvil and his sledge are all coated with electricity; and when he tells us that the sudden destroying of *motion* makes heat, we may object. The woodman's saw, when not greased, has a blanket of electricity on either side of it. Of course it will heat by friction. When the woodman gives it a coat of grease he does the best possible thing to keep the electricity off. If you can get an electric spark by rubbing a cat's back, or by touching your toe to the carpet, no wonder you can get it by rubbing two sticks together, or from the steel and flint. You will observe most of Prof. Tyndall's beautiful experiments, illustrating the dynamic theory of heat, were made in connection with the electric pile and the magnet and coil. He tells us that working a saw through a strong current of electricty, it seems as though it were being pulled through cheese, and that it soon becomes very hot. All of which is as we might expect. If the reader wants more proof that the heat of friction is from electricity let him look it up for himself. He will find it about him on every side.

Electricity moving unimpeded gives us no heat. In that case its heat continues latent. It is when it is crowded that heat is given off, as every electrician knows. When it gives us heat some electricity is destroyed, and as a result heat is set free. So color-rays are destroyed and heat is set free. So oxygen is destroyed and heat is set free. Electricity is easily destroyed when it is massed on solids. It can be done by concussion, by friction, and by chemical actions that either appropriate its matter and free its heat, or appropriate its heat and free its matter. It can be destroyed by its own crowding as it passes over defective points of the conducting medium, or by its leaps as it passes from proximate conductors. As the sparks pass from one body to the other, minute particles of the first body are deposited on the second. This shows the strong attraction by which the electricity clothed itself with particles of the metal over which it passes. It shows also that the crowding and concussion destroyed electricity, and caused a depositing of its matter, and as you might expect the result is great heat. As

its current was caused by its own repellent force, we have proof here for every principle I have advanced. Proof of the affinity, proof of the dual nature of the element, proof of the repulsion.

These subtle gases are forever grasping whatever they can lay hands on, and they are running away with all, according to their ability. You cannot see their operations, but your olfactory nerve gives some account of their proceeding and "the half hath never been told."

In connection with odors, all here advanced finds the strongest confirmation. Radiant heat is destroyed or becomes latent in connection with all odors. Passing radiant heat through dry air, nitrogen, or hydrogen, very little of it is lost. Calling this loss 1, the loss in passing it through ammonia is 7260, through sulphuric acid 8800. You may say it is stricken down, but it affiliates with the matter and becomes latent. By passing radiant heat through vapors, still greater differences are manifested. In passing heat through ozone, both the heat and the ozone become lost, as they enter into combination. But enough of this. It is as plain as the sunlight in the heavens, that heat enters into composition with the most infinitesimal particles of matter. This is the atom. Out of these atoms come molecules, and gases, and fluids, and solids.

A few thoughts more may be presented as having some bearing on the discussion. We have the laws of reflection of light, and of heat. This reflection comes from a rebound, or from elasticity, as when a rubber ball is thrown against a smooth surface. We can conceive of the most tiny atoms rebounding. But can a wave rebound? That a motion should rebound is unthinkable. That a wave should rebound is absurd. The reflection of light and of heat seems to demand an atomic theory.

Again, we have the laws of the refraction of light, and of heat. The solar spectrum shows that heat is refracted less than light, and light less than the chemical-rays. That is, the heavier the enswarthment of the heat atom, the greater the refraction. That is just as we would expect. We all agree that refraction results, first, from a check to velocity given on entering the denser medium; and second, from the acceleration obtained on passing out of it. An atom can receive the check more readily than the wave. Will some one please tell us how the wave will receive acceleration on going out? Explain to us how anything, whose motion depends on the force with which it started, being once retarded, will receive acceleration? The thing is absurd. But, on my theory, as all these rays approach the earth, they have new impulse, from that powerful affinity out of which grows all attraction. What better confirmation could we want? And this leads to the remark, that perhaps nature is not so prodigal as to send out into all empty space, the source of blessings that are shed upon us.

I want to say this on radiation. The molecules of water becoming heated, expand and rise. We say they carry heat by convection. So the molecules of air becoming heated, expand and rise. They, too, carry heat by convection. It is well known that the air carries *electricity* by convection. The air-molecule becoming charged, is repelled; at some distant point it unloads its cargo, then returns

again, is charged, and again repelled. Gases too minute for observation may perform the same service for heat, and this may be the philosophy of radiation. Perhaps it is by the speedy flight of the molecules through all solids that heat is disseminated through them. This is more simple than that other theory that asks us to believe that there is an everlasting kicking and stirring of the solid particles. I would not be understood as believing that heat needs a chariot for its conveyance. It is, no doubt, able to travel alone. And alone, its affinity is all the stronger for the object of its pursuit.

How harmonious are the workings of nature. And all fits so beautifully to this theory. Look, for example, at polarization: solids crystalize as they solidify; crystalization being polarization under other conditions. So this thing runs through nature. In the laboratory, the chemist sees polarization in a thousand curious forms. We have the polarization of electricity, the polarization of light, and the polarization of heat. Why not allow the whole class to be of a kind, when they are so alike in their behavior? Wherever we touch these matters this kinship is proclaimed. My theory of affinity and repulsion gives us the philosophy of polarization. The nature of the atom, when it becomes a compound, makes polarization almost a necessity. This theory also gives us the philosophy of radiation, and of elasticity.

What a breaking up of family ties when heat and light are put off into a strange place. Notice the parallelisms. Take latent heat. We have it in solids, in gases, in electricity, in chemical-rays, in color-rays. Take elasticity: We have it in solids, in gases, in electricity, in chemical-rays, in color-rays, and in heat. Take polarization: We have it in solids, in chemical compounds, in gases, in electricity, in light, and in heat. Take chemical factors: The various elements, gases, electricity, chemical-rays, color-rays, heat, all are chemical factors; each definite in its operations in every condition in which it acts.

As to conduction through different metals compare electricity and heat. They are as like as twins. In all the standard books we have the following table of conductivity:

Name of Substance.	CONDUCTIVITY. For Electricity.	For Heat.
Silver	100	100
Copper	73	74
Gold	59	53
Brass	22	24
Tin	23	15
Iron	13	12
Lead	11	9
Platinum	10	8
German Silver	6	6
Bismuth	2	2

If heat is only a mode of motion, then electricity is only a mode of motion. And from their kinship as shown in conduction it must be much the same kind

of motion of the same kind of invisible ether. Electricity and heat are surely very much of the same nature. Is electricity only a mode of motion? Believe it who can.

I will not be surprised if some things that are erroneous shall be found in this paper. I will be surprised if its main positions are not sooner or later accepted by men of science. Those who are too established, to re-invoice the storehouse of their knowledge, will likely remain where they are, at least, till they follow the multitude. But there is a spirit abroad in the land that asks even what is called science to show its authority. This spirit was never more active and more earnest than now, and the truth is going to lose nothing when it goes forth in methods of legitimate operation. I respectfully ask that the themes here discussed receive from this class of minds serious consideration. Having held to these views for the last eight years, I have gone with them into different realms of science, and everywhere they have caused me to see with a clearer light. This is so in astronomy, in geology, in meteorology, and in all that pertains to organic nature.

After all, it is not so much that need be thrown away. Thermodynamics is indeed a science, and here "the half has never been told." Heat is the source of force. It causes motion. It may be said to accomplish work. Yes, surely, if it be the source of all attraction and of all repulsion. Scientists may measure its force, and if they choose they may reckon it by foot-pounds. To all this we have no objection; we are pleased. And we expect to see a great deal more done in these directions. Go on gentlemen, nor stop till you find a perfect system of applied mathematics running throughout the whole physical world. It is there, whether you will be able to gather it up, or not. But all this makes nothing for the theory that heat is only a mode of motion.

SELENIUM AND ITS USES.

Selenium is an elementary substance that is found in nature associated with deposits of sulphur. It was discovered in 1817 by Berzelius. This somewhat rare element crystallizes in four sided prisms, and is about four times as heavy as water. It is as brittle as glass, but, unlike the latter substance, is readily cut or scratched. Selenium, when suddenly cooled from a fused state, possesses a reddish-brown, metallic lustre with a conchoidal fracture, which by exposure to the air, assumes a dull, leaden-gray color. The name, selenium, is derived from the Greek word *Selene*, the moon. When rapidly cooled from a state of fusion, selenium is a non-conductor of electricity, but when cooled very slowly it is a conductor. In this latter condition it possesses a granular appearance and a metallic lustre.

It was during the experiments of Willougby Smith that an exceedingly valuable property of selenium was discovered. While making some experiments in his system of cable testing, he was considerably puzzled by the extreme variabil-

ity in the results he obtained. Persistent efforts in tracing the cause of these discrepancies resulted in the extremely valuable discovery that the electrical resistance of selenium was less while exposed to sun light than when in the dark. This valuable discovery was made in May, 1872, and was communicated to the Society of Telegraph Engineers on the 17th of February, 1873. His apparatus consisted of platinum wires, inserted into the opposite ends of a bar of selenium, hermetically sealed in a glass tube. This was placed in a dark box and suitably connected with instruments by means of which its electrical resistance could be measured. When so arranged, the exposure to the light, consequent on opening the lid of the box, caused an instantaneous reduction in the resistance. So sensitive was this arrangement to the action of light that merely placing the hand between the selenium bar and the light of a distant gas burner, instantly affected the instrument.

The discovery of this curious property of selenium naturally attracted considerable attention from scientific men in different parts of the world, and numerous investigations were made concerning its properties, for example: Professor Adams, of Kings' College, showed that the greenish-yellow rays were the most effective in varying the resistance of selenium, and Professor Siemens produced a variety of selenium that was fifteen times as great a conductor of electricity in the light as in the dark.

Among some of the more interesting applications of the variations in the electrical resistance of selenium, by the action of light we may mention the "selenium eye," in which an attempt was made to imitate the action of light on the iris of the human eye. By an ingenious use of selenium resistances, introduced into the circuit of a battery, the inventor caused the intensity of the light that entered a lens to be maintained approximately constant by the action of an electro-magnet that varied the size of the opening of a diaphragm, in this manner roughly imitating the contraction and dilatation of the pupil of the eye.

Perhaps one of the most famous uses of this property of selenium, was made by Alexander Graham Bell, of telephone celebrity. This inventor, in an instrument he termed a telephote, has so utilized the variations in the electrical resistance of selenium while under the influence of light, as to be able actually to hold telephonic communication along a ray of light instead of along the customary metallic wire. The telephote is now generally known under the general name of radiophone.

Numerous attempts have been made, in different parts of the world, to utilize this variation in the electrical resistance of selenium under the influence of light for the transmission of photographs, or, outline sketches, by electricity. Some of these attempts have been comparatively successful, and we may in a subsequent issue discuss them in detail.

We shall not be found wanting in the Exhibition in a display of this curious element. A single exhibitor has applied for space for an exhibit of selenium resistances that he values at $10,000. An application has also been made by a French savant who contemplates exhibiting an instrument called the telectro-

scope, designed to transmit photographic images by means of electricity, by the use of selenium resistances.—*Electrical Review.*

ARCHÆOLOGY.

DID THE ROMANS COLONIZE AMERICA?

M. V. MOORE.

I. PROBLEMS AND FACTORS.—Who first colonized the Western Continent? From what far-off land came the primal pioneer to the shores of America? When and where, and over what trackless seas did he sail?

Who was the mother, who was the father, and what was the language lisped by the first-born under the western skies?

These are profound questions, which have agitated the minds of men for centuries. Science has wrestled long and earnestly with the mysteries surrounding the Red man; but the wisdom of the wisest has failed in reaching any satisfactory conclusions. The voice of History is silent, giving no response to the long-pressed queries, and even the tongue of Tradition tells not its vague and uncertain tale concerning the origin of the earliest peoples of the western world. There remains not so much as a hieroglyphic in which may be traced the faintest vestige of the birthplace or language of their sires.

The Indian is enigmatic. He is the profoundest historical problem of all the ages He is not, however, involved in such mazes of darkness and confusion that there is no clue to the truth. We have well-defined bases upon which to proceed. There are three well-known factors presented in the problems; upon these alone now depend all legitimate calculations if we expect to obtain any trustworthy results.

The prehistoric peoples of America are revealed to us in custom or character; and also in art and in language. There are fragmentary remains of each of these all over the continent. The naturalist takes a fossil, and from that fossil he delineates an extinct species. Can we take the fragmentary remains pertaining to the dead races of the continent, and construct therefrom the skeleton of a truth? The testimonies we have indicate that there was once a people in America possessed of a high order of civilization. The savages of to-day represent the degenerate and retrograding sons of illustrious sires. Hints of the culture of the ancient Americans are yet found in many places in the land. Our prehistoric ruins reflect not only a high order of art, but art founded upon pre-existent models known in old civilizations. This art displays a mind and a hand trained in the schools of science. The civilization and art of the American were yet flourishing when the conquests of the Spaniards, Cortes and Pizarro, put an end to

their vitality. There were—and are yet—visible deep impresses in the character of the Aborigines—the distinct marks of nationality—made by the silent but sure forces of thought and habit for countless ages. These, doubtless, descended from the earliest generations here. They indicate, beyond question, an antecedent type long existent somewhere in history.[1] Thirdly, the language of the earliest colonists of America is full of evidences of illustrious birth. Those people were neither beast nor savage. Their speech was not the gibberish of the untutored barbarian; it was, indeed, a speech which by common consent had origin in cultured minds.

The three factors in our problems are all productive or illustrative of civilization. What era in the world's history does that civilization represent?

The answer to this query—the index to the theory of these papers—lies in the title we have chosen, "Did the Romans colonize America?"

We consider first the most universal of the testimonies reflecting the Indian's origin. We say universal, for whithersoever the man wandered over the continent, he left behind him as a testimonial, the shreds of his language. Let us see if we can unravel the strange woof contained in the words found here representing the earliest peoples of the Western World. Mr. Jefferson in "Notes on Virginia," has said that "a knowledge of their several languages would be the most certain evidence of their common derivation. . . . Were vocabularies formed of all the languages spoken in North and South America, *preserving their appellations* . . . it would furnish opportunities . . . to construct the best evidence of the derivation of this part of the human family." This, indeed, touches the very key-note of the subject. The appellations of a nation are always indicative of their origin. This fact is observable all over the world. German people usually do not adopt French names. Nor does the nomenclature of France savor of Ireland or China. China does not borrow her words from the Hottentot of Africa, nor from the nations of Britain. And whence, then, came the "appellations" of the Aborigines of America?

The most common, and the most universal, and at the same time the most ancient, of the Indian "appellations" have been "preserved." They are the river names of the continent. These words are the very oldest testimonies that exist, delineating the speech of the earliest dominant races in America. Exactly how old they are, it is impossible to tell. But it is well known that they are not the coinage of the rude people found here in the 15th and 16th centuries, any more than that the names of the rivers of the Old World are due to the present nations there. All geographical nomenclature, with rare exceptions, belongs to remote periods—much of it in the Old World, as well as in the New, to the prehistoric ages.[2] The Indian names of our rivers belong to a period when one common language was known, when one dominant race ruled, throughout the

1 See Irving's "Life and Voyages of Columbus," Vol. I, pages 139-141. This authority is quoted as more convenient and accessible to the general reader than the Spanish originals to which Irving refers.

2 The origin of many of the most common European and Asiatic names on the maps of the world is unknown.

entire length and breadth of America. These names illustrate or indicate the language of the men who colonized the continent.

How do we know these facts?

* * * * * * *

All the primitive peoples of earth are known to have used in the structure of their river nomenclatures, the same common and universal syllabic expressions, designated as "terms"; and which are the ancient exponents or significants of our words water and river, with their varying conditions. These terms are known to man under every condition of his existence, whether civilized or barbarian; they are traced backwards, through the intervening tongues, to the oldest of all known languages. The American Indian uses the same terms in his river-names that were used by all the aggressive races that overran and colonized Europe, Asia, and Africa.

Writers on language usually denominate that wide embrace of speech which immediately antedates the historical tongues as the Semitic Language.[3] From the Semitic root have sprung three great branches—the Hebrew, the Chaldee (or Aramean), and the Arabic. While each of these has had its countless offshoots and dialects, directly to these three may be traced the historical languages of civilization, and in which are found all the ancient terms for water and river, now known, either in purity or with mere variation and verbal corruptions, in all the river nomenclatures of the world, including that of the Americas. There is no corruption or abbreviation of those ancient terms known to the Oriental or European languages but what an identical word is found to match it in the river names of the Western Continent. And yet not only does the Indian show familiarity with the ancient terms for water and river, but he had knowledge also of other terms unknown to the ancients up to a certain period in historical annals. That period embraces the Latin.

A glance at terms themselves may enable us to have a more definite understanding of the problems before us--a more intelligent idea of the manner in which the Indian showed his familiarity with the tongues of civilization. By comparative illustrations, we may be able to trace the Indian down through all the historical eras represented by Hebrew, Sanscrit, Celtic, Phœnician, Arabic, Persian, Indo Germanic, and even through the Greek into the bosom of the Roman. *And if the testimonies of philology have any value in determining historic truth, we may find the earliest colonists of the Western Continent in a people reaching its shores from what is now a province on the western coast of the Kingdom of Italy.*

Startling as this proposition may seem, it is made in the sober conviction of its truth. But to illustrate fully all the evidences showing the Indian's familiarity with the historic languages of the Old World, from the Hebrew to the Roman,

3 Lying still beyond the Semitic is what is usually denominated the Germ Language—a language of brief roots, or germs, which make up the great body of known tongues. All modern languages are chiefly composite—their composite character obtained from what are now generally regarded "dead languages," with modern types of the old. The dead languages were also composite to a great extent. They were made up of those brief roots which had birth in the primal speech of man—the Germ Language.

would detail upon the writer the task of a volume in itself, occupying more than our allotted space in this paper. Deferring that duty to a future issue, we shall have to content ourselves in this with a few brief examples.

* * * * * * *

One of the most ancient river-names now known—Abana of Damascus—contains two of our terms. As this word has never since been applied to the river (at least so far as is known), it is supposed that Naaman the leper, who first used the expression historically, applied the traditional name to the waters—for he was a learned man, supposed to have been versed in the traditional lore of his country.

The two terms in this name are Aba and Na. The actual translation of the word as a Hebrew expression makes it "waters" "sure,"—that is waters that flow certainly, with perpetuity. (Isaiah xxxiii., 16.)

In the Hebrew (where the word is found both as Abana and Amana, the consonants B and M being often used interchangeably) the letter M is the brief significant of the word for water; its full expression is Mo or Ma. (In the original Hebrew the vowels are omitted, and the reader or translator is often allowed to supply the omission according to his own conjecture. So says Gesenius, the great authority in ancient languages.)[4]

Languages which are dialects of, or cognate with, the Hebrew, use varying expressions of the term Aba for river or water. The Sanscrit, which also omitted the vowels, often had Ap as the significant of water. In the Dacian or Wallachian, the word is written Apa. These are the same as Aba, for B and P are often used interchangeably in the languages of old. The Persian expression of Aba is in Ab, with the pronunciation and frequent writing of Aub.

The Arabic of the word is the final syllable, Ba; or, as sometimes written, Bar or Bahr, the latter containing a hint of an additional term known in the river nomenclature of all nations—the Sanscrit word Ri. As the consonants L and R are used interchangeably also in many languages, this latter term is often found rendered Li.

The idea expressed in the primitive term Ri, is that of a restless, rapid, rushing current—a stream, a torrent, or a cataract. Its coinage was perhaps due to an onomatopic principle developing in the mind of the earliest philosopher. The term is found now in the river nomenclatures of every people under the sun, and always expressive of the rippling, rapid water. It has received many differing expressions in the written languages of man. We see it in the Brahmapootra of Asia; in the Nachar and Niger of Africa; in the Rhine, the Rhone, and the Dneister of Europe, and in America it is in Missouri and Niagara, and in countless other river names, not only in America, but elsewhere all over the world. In the name Niagara, Ri appears written with A, while the term Na is rendered with I, the true word being really Naagari (or more correctly still Naoghari. All our Indian words are written in mere conjectural or fanciful orthography, as we shall see more clearly as we proceed).

4 Hebrew Grammar, page 22 (Dr. Roediger). Appletons. 1868. Comp. remarks, page 5, also.

In the name Niagara, an additional factor or term is seen—"aga," or really Ogha.

In the early Semitic or Germ language, there was another word for river, in addition to the term Aba, which is supposed to be often merely *water*. It is, however, impossible now to give the original word a definite expression. The Hebrew, the Sanscrit, and the Celtic have slightly varying orthographies for it. In our ordinary transcripts, or versions, of the Sanscrit, the term appears as Ogha. The English word *ocean* is traced to this term. The Celtic language has the term written Acha, or Achi; and from which the Latin word *acva* or *aqua* comes. These words are given in our lexicons as the significants of water or river.

In the ancient Germanic or Teutonic language of Europe the term has been rendered Aha or Ahha, our authorities stating that this is also a *correct pronunciation* of the Celtic Acha. Writers on language usually refer to the word Aha as the Germanic equivalent of the words Acha, Apa, and Aqua—water or river. Probably the facts are that Aba and the group of terms owing their origin to it, variously rendered in B and P, making really one primitive word, was in the ancient speech the true term for water, while the word written with G, C, Ch, and Q, refers always to the running river, with the possible exception of the Latin *aqua*, which is expressive of either water or river. Aha may be considered simply as the ancient Teutonic expression of Acha, as it is known that defect has existed for countless ages in the German tongues, preventing their pronunciation of certain digraphs in speech—a fact we shall have occasion to refer to again.

There are developed so far but two of the ancient terms for water and river, Aba and Ogha. Na, while not purely an adjective, was expressive of the constantly flowing water. There was another term in the ancient speech expressive of the character of the water. It is the syllable De (often rendered "dee"). It is seen in the Sanscrit words Dena and Deap; and it is supposed to be the root of our English word "deep," this coming, says Webster, from the Anglo Saxon *deop*, the same as the Sanscrit *deap*, meaning the deep waters, as the sea. Dena is the flowing deep water, while Rina, another Sanscrit word, is the rapid flowing water. Dena, Depa, and deap are all analogous if not identical. It is well known that D and T often interchange in languages—one being used for the other. Our authorities state that the Indian word now written Tippa is correctly rendered *Depa*. (See Lippincott's Pronouncing Gazetteer.)

It is scarcely necessary to burden these pages with full illustrations of the manner in which these ancient terms have entered the river nomenclatures of the Old World. They are seen in purity and corruption everywhere there, and they are so imbedded in the historical languages that references are superfluous. One fact should be remembered—the vowel sounds, especially in the terms, are given all manner of writings. This is due to the fact that the expressions of sounds have no common uniform and arbitrary orthographies in the language of men.

In the Old World especially, where *a* is often rendered in *o* and *u*,[5] we see, for instance, that Aba is written Oba and Uba, and Obi and Ubi. These are the names of Russian rivers. We write the same thing in our Indian nomenclature, Obey (a river in Tennessee), and Yuba, a river in California, while in Africa one of the native (Bari) names of the Nile is given as Yubiri—Aba with the addition of the term Ri.

The Persian method of expressing Aba, is in Aub, or Ab, is seen in the Asiatic rivers Punjaub, Murjaub, and Chenaub or Chenab. The term is not confined to Persia alone. France has a river named Aube. There are more than fifty rivers in Europe showing the presence of Aba and Apa in their names. The Indian nomenclature shows a like number. The reader's memory can call up the names. The Persian sound is heard in the names Catawba, Senatoba, Manitoba, and others; while the pure Sanscrit or Dacian expression is found in such names as Apa-lacha, Al-apa-haw, Sax-apa-haw, Caniapuscaw, and in the original of the word Mississippi, which was Messi-apa. The very name Abana is found in the Indian word written Abanay.

In the former of these illustrations (in Apalacha) we see the Celtic Acha in connection with the Sanscrit Ap. In two others we see the Germanic term Aha (haw), and in the three others we find with the ancient term for river prefixes well known in the Latin—prefixes which are unmistakably adjectives of modern birth.

Apa is rendered with O in the European river names, written Oppa (in Italy and Silesia also). It is written with O in the Indian names Opequan and Opelika, and numerous others. The Po (once the *Padus* or Padee River of Italy) gets its title from Apa. The final vowel is often written with O in the Indian, as in Appomatox, Appodee, and in many others. It is written with U also, as in Appuremac.

Aba and Apa are often rendered with the vowel *i*, as in Mississippi, Osippe, Caribee, and Abbatibbe. In the ancient name Jolibah of Africa (once the Niger), and in the Meribah of the Hebrew we see the same term.

The Celtic term Acha is found in a score of instances in the Indian river names in absolute purity, often alone, as in our numerous Hatchies. It is more frequently joined with a modern descriptive epithet. (By the term "modern," as used in this and a previous paragraph, I refer to the historical periods.) We see the Celtic word in Oswegatchie, Caloosatalchie, Choctawhatchie, etc.

Acha is found in river nomenclatures all over the world. In Sicily is a river —the name is pronounced *Atchee*, but the writing of the word there is Acè. Sumatra has Atcheen. Acheen in Germany is pronounced nearly *Ockeen*. Nearly all the German river words showing the Celtic root Acha with the C sounded, give this consonant the hard or K sound. Aach—a river there—is pronounced *Ak*. This pronunciation of the syllable Ach is prevalent all over the world. It

5 It is very common to find in the Old World words which have origin in those primitive languages which were chiefly consonantal in structure, now written with either of the vowel sounds.

is so similar in many instances to the sound of the initial syllable in the Sanscrit term Ogha that it is often a difficult matter to determine to which word a corruption is due—whether to Ogha or Acha, as in the word Niagara. The "aga" here may be traced to the sound of either (though the terms themselves are really one and the same).

This recognized difficulty is more conspicuous in the Indian nomenclature than in the names of the Old World—due to the manner in which we have received the Aboriginal names in America. Yet even in the existent writings of the Indian words we find very striking similarities and analogies every way to these names in the words of the Old World. We have space for but few illustrations in this paper. We notice only a few.

The Indian name Saratoga has an exact counterpart in the Saratowka of Russia. The word Sara itself is in many names in America and the Old World besides.[6] All over the Old World are Garris and Garras. We have in the Indian Garry and Gauriba. All over the Old World are Looris or Luris. The same word is written more than once in our Indian names Luray. Lu is a corruption of Li (for Ri). In African nomenclature the same words are written with either Ru or Lu—as in Rubumba, which is also Luvemba. Africa has the river Ruanna. In our Indian nomenclature the same word shows the Latin root in the way it is now written—Rivanna. The vowel is sometimes written in O, in Africa. We find there the Lowando. In America we have it simply Wando. In Africa is Monongah. In America we have Monongahela—in the "ela," a well-known Latin word is seen. (The meanings of these words will be discussed in future.) In Africa is the Kyogia. We have in New York the Cayuga—pronunciations almost identical.

All over the Old World we find the word Coosey or Koosi, in the river names. There are more than a dozen Coosas in the Indian. The word Moose is also a "native Indian name." Yet in Europe and Asia it is seen written Mousa. The Wolga is a river in Europe; the Wolkee a river in Alabama. In Africa is the Congo. In America is the Concho, and also the Congaree—the Sanscrit Ri added. Sarabat is in Asia; Sarabita is in South America.

The name Mississippi was originally Messisapa, which is not unlike Mesopotamia, of Asia. Our fanciful name Tennessee was once Tenassy (or *Tenacha*), like the other Asiatic word Tenassarim. The Genesee of New York is like the Yenessee of Russia. Yemasie is also similar; Onega of Russia is similar to Oneida of America.

The word Shocco or Soco is in the Hebrew of the Old Testament. It is also a river in Europe. As Shockoe and Saco, it is in the Indian nomenclature from Maine to North Carolina. Saranac is in the New York; Sarawak is in Borneo, and Saramacca is in South America. Chili of South America is heard in

6 Sara is a river in Russia, Switzerland, France, and in Louisiana. It is Sarari in Brazil—another term added. Tigris—*Tegree* or Tiegra—is found in river nomenclature in Asia and in America in several places. Tigre is in Africa.

the Japan river name Pee-chee-lee. Ujiji of Africa finds its likeness in the Jujuy of the Indian.

Oochee (which is a corruption of either Acha or Ogha) is found in many river names of the world—in Russia, China, France, Scotland, and often in the Indian. From this term comes the word written by our early French explorers, Ouachita (now Washita or Wichita). We find what is perhaps identically the same thing in a French transcript of a Polish name—Ouchitza. The name Canoochee of the Aboriginal American, and which is very like the Asiatic word Canojia, gives us a descriptive epithet which is evidently borrowed from the Greek. There are more than a score of the Indian names applying to the rivers bordered by the canes—names having in their structure the Greek *canna*. We shall refer to them again.

The above examples—selected at random, and without any effort to give the fullest analogies in the Indian nomenclature to those of the Old World—certainly convey the idea that the river names of America were not devised in utter ignorance of the language of the Old World. Countless other testimonies could be adduced showing the verbal analogies of the Indian to those of the civilized people of the Eastern Continent. The occasional use by the Indian of similar syllabic expressions, or even coincident phrases and complete words found in the speech of unknown people in remote countries, could be accounted for on the ground of accidentality or otherwise. Yet the nomenclatures of the Red man—his "appellations"—are too full of similarity and actual identity with the words of the Old World for us to doubt for a moment the earliest colonist's knowledge of the pre-existent models. We must confess that there is revealed by the Indian names a knowledge of the historical languages and their etymological laws governing the coinage of words.

We have seen some of the examples of the Indian familiarity with terms having origin in languages antedating the Latin. Let us now see if his knowledge extended through, or embraced the speech of the Romans. Let us see if we can detect in the river nomenclature of American Aborigines a knowledge of idioms and phrases that cannot be traced beyond the limits of the Latin into an anterior tongue. When we shall have seen the testimonials relating to the origin of the earliest colonists of America as they are revealed by the language of those people, we shall then consider the analogies existing in Character and Art.—*Magazine of American History.*

[*To be Continued.*]

DEATH OF "BLACK-BIRD."

A. R. FULTON.

I have read the interesting article of Mr. Collett in the August number of the REVIEW, regarding the death of the celebrated Maha chief, Black-Bird, in

which he concludes from the evidence he gives, that the chief died in the year 1802. Mr. Collett is certainly nearer the date of that event than some other writers to whom he refers. I am inclined, however, to believe, from the record left by the celebrated explorers, Lewis and Clarke, that the death of Black-Bird occurred about two years earlier.

Captains Lewis and Clarke set out on their voyage of exploration from the mouth of Wood River, May 14, 1804. On the 10th day of August of the same year they reached, as they state in their journal, a highland on the Missouri River, near the spot where Black-Bird, one of the great chiefs of the Mahas, died of small-pox *four years before*.. This would fix the date of the death of that chief in the first year of the present century—1800. They described the place of his burial as "a hill of yellow, soft sandstone, which rises from the river in bluffs of various heights, till it ends in a knoll about three hundred feet above the water. On the top of this a mound of twelve feet diameter at the base, and six feet high, is raised over the deceased king." They further record that they placed upon this mound "a white flag bordered with red, blue and white."

Speaking further in regard to the chief, Lewis and Clarke say: "Black-Bird seems to have been a personage of great consideration, for ever since his death he is supplied with provisions, from time to time, by the superstitious regard of the Mahas."

Near the place of Black-Bird's burial the Mahas had a village where four hundred of their warriors died at the time when Black-Bird was taken from them by the same malady. Lewis and Clarke calculate the latitude of this village as 42° 1′ 3.8″ N. Speaking further of the village, they say it was about five miles from their camp (on the Missouri); that it had once consisted of three hundred cabins, "but was burned *about four years ago*, soon after the small-pox had destroyed four hundred men, and a proportion of women and children."

The Indians described to the explorers the dreadful ravages of the malady, which had carried away so many of their people, but Lewis and Clarke could not learn in what way the disease had been communicated to them. They supposed it was through some war party, as the Mahas had been a warlike and powerful people. "When the warriors saw their strength wasting before a malady they could not resist, their frenzy was extreme; they burned their village, and many of them put to death their wives and children, to save them from so cruel an affliction, and that all might go together to a better country." Such is the account given of Black-Bird and the great scourge which came upon his people, by so reliable an authority as Captains Lewis and Clarke.

The explorers remained with the Mahas several days, during which time they obtained much information in regard to their history and their relations with the neighboring tribes. The account which they obtained in regard to the great chief, Black-Bird, is certainly quite conclusive as to the time and manner of his death and burial. The evidence given in their journal quite definitely points to the year 1800 as that in which occurred the death of the great chief and the calamity which destroyed so many of his people.

The location of the ancient Maha village, the scene of Black-Bird's death, was on the Nebraska side of the Missouri River, about twenty miles above the mouth of the Little Sioux River, a stream which flows into the Missouri on the Iowa side. Some hills, or highlands, in northeastern Nebraska, are known at the present time as "Black-Bird Hills," in memory of the great chief who for many years held supreme rule over the destinies of a once powerful and warlike tribe, which has given to the State of Nebraska the name of its principal city—Omaha (O-Maha).

DES MOINES, IOWA, August, 1884.

ENGINEERING.

THE PARIS WOOD PAVEMENTS.

The repairing of the Grand Boulevards has just been completed, and the Parisians are justly proud of their new roadways, which are now covered with wood, and as smooth and clean as a ship's deck. This transformation in the streets of Paris was forced upon the municipal authorities. The very expensive system of sewerage, with its canals and railways, which has long been regarded as one of the most curious sights of the French capital, was greatly obstructed by the immense quantities of sand which every heavy rain washed into the sewers from the Macadam roads. Although the sewers are flooded every day with water from the Seine, it was found impossible to remove the sand which got in from the streets except by actually digging it out, at a cost of more than two millions of francs per annum. Several committees composed of engineers, hygienists and architects were appointed to find a remedy for this obstruction to the sewers, and as a result of the joint investigation of all these worthies, it was finally resolved to abandon the Macadam roads, because they were the source of so much trouble in the sewers.

The Engineers of Bridges and Highways were then sent to London to examine into the system of paving adopted in that metropolis, and they agreed, after much study, to invite the Improved Wood Pavement Company to lay down a specimen of its pavement in Paris. The conditions of the contract were peculiarly onerous, and nothing but a full confidence in the merits of their system could have warranted the company in accepting it. The company agreed to lay down its pavement at the intersection of the Rue Montmartre and the boulevard of the same name—a point dignified with the appellation of the *Carrefour des Ecrases* (Smash-up Square) on account of the immense traffic and crowding there. It was further agreed that the company was to wait two years for its money, which was not to be paid even then unless the pavements were in a perfectly good condition. This was in 1881. The wooden blocks were laid down, and

stood the test beyond the most sanguine expectations. Actual measurement showed that the pavement had not moved one five-hundredth part of an inch during two years, and it was never once repaired, while the asphalt on the same street had never lasted more than two consecutive months without repairs. The stone pavement which had preceded the asphalt was also in need of constant mending.

The repaving of a large portion of the superb drive-way in the Champs Elysees was also done by this Wood Pavement Company, of London. These severe tests demonstrated the perfection of the new system, and a French company was formed which has latterly repaved the Grand Boulevards, the Avenue de l'Opera, the Rue Royale, where night and day there is a stupendous traffic, the Rue de Rivoli and many other of the principal streets and avenues—in all some 400,000 square meters, or about twenty miles of roadway. The system is now being extended to the Boulevard Haussmann, and is to be carried out all through the splendid new quarter on the left side of the River Seine.

The only system now in use here may be briefly described as an artificial stone pavement, perfectly rigid and smooth, covered with wood. In order to pave the roadway it is first excavated to the depth of twelve inches. A foundation of concrete six inches thick, composed of Portland cement, washed gravel and clean sand, is then carefully laid, and made to conform exactly to the contour intended to be given to the top surface of the roadway. Before this concrete is set or dry, a layer of very fine mortar, also made of Portland cement and sand, is spread over it in a semi-liquid state, which leaves a perfectly smooth surface. When dry this artificial stone foundation is almost as hard as granite, and forms an arch extending from curb to curb. All the weight of the traffic is supported by this foundation; the wooden blocks are used simply to protect it, and at the same time to afford to the wheels a smooth, elastic and noiseless way. The English and French engineers lay great stress on this point. On the concreted stone pavement or foundation, then, a wood covering, six inches deep, is placed. The blocks, which are usually 6x9x3, are placed on end in direction of the fibre, directly on the concrete foundation, in rows across the street, leaving a space between each row of about three-eighths of an inch. Boiling asphalt is then run into this space, and forms a species of shoe around each block, cementing them all together and to the foundation. The remaining space between the blocks, about five inches, is then filled with Portland cement grouting. The top surface is covered with fine gravel, and the pavement is allowed to dry.

The company guarantees to keep the pavement in perfect order for eighteen years, the city paying them 5 francs 37 centimes per square meter per annum. Of this the city retains 1 franc 95 centimes per square meter per annum as a guarantee and sinking fund for repairs, etc. At fixed periods—every six years—the pavement is inspected, and if it is found to be in good order, the sinking fund is paid over to the company, and a new sinking fund formed.

The greatest advantage obtained for the dwellers in this crowded capital by the adoption of this pavement (Kerr's system) is the cessation of the crashing

and rumbling noises caused by huge vehicles. The ponderous double-decked omnibuses, with their three stalwart white horses at the pole, go over this new pavement, almost as silently as a swallow skims the air. I am writing this epistle in my office, which is separated from the Boulevard des Capucines, one of the most crowded streets in the world, only by the width of a courtyard with wide entrances, yet no noise of vehicles offends my ears. There is no thunder of Broadway here. The only noise which troubles me just now is made by an energetic French gentleman with rosy complexion, who, seated at a table in a room on the opposite side of the inner court, is crying out: "*Deux mille deux fois! Deux mille trois fois!*" and so farther, as the Germans say. As he is within the precincts of a club, I am doubtless right in imagining that his enthusiasm is not entirely disconnected with cards. But that is merely a passing suspicion. My point is that, thanks to the ædiles, we have reached a pass at which men make more noise than vehicles in Paris. How precious would the wooden pavement be on lower Broadway and on the crowded streets by the water side in New York. I suppose there are more private carriages in this city than any other capital in the world, and it seems to me that they scurry home at all hours of the night. One slumbers with no danger of being disturbed by them. The wooden pavement presents so many advantages over stone and asphalt that it is likely to come into general use throughout Europe. The three years' study of the French engineers in London are accepted by engineers of other continental cities as conclusive. The present pavement is an improvement, or rather the result of a long series of improvements, on the American system, which was introduced into London in 1872. The annuity system of payment adopted here presents advantages peculiarly adaptable to American cities, enabling the abutter to calculate a long time in advance what his charges are likely to be, and keeping him out of the hands of "rings" and other detrimental combinations permitted where city politics are corrupt. Every growing city has much to gain by extending its paving contracts over eighteen or twenty-one years, instead of paving occasional large assessments for the mistakes or caprices of would-be improvers. Experiments are henceforth useless; any municipality following the Paris model will find itself completely satisfied.—*Cor. N. Y. Evening Post.*

RELATIVE RIGHTS OF RAILROAD COMPANIES AND THE PUBLIC.[1]

There have been two recent decisions of our Supreme Court in cases not only affecting very important local interests but also involving questions the solution of which vitally concerns the public welfare. These decisions are in settlement of the controversies in regard to transportation facilities at the Savannah depot and the dismantling of the narrow-gauge railroad between Kansas City and Independence. One question involved directly in one of these cases, and re-

1 From the Ninth Annual Report of the Railroad Commissioners of the State of Missouri.

motely in the other is, in what sense or to what extent is a railroad a "public highway." That it is a public highway is not to be questioned in Missouri. No matter how many conflicting laws or judicial decisions there may be on this subject in other States, the question is settled here by our State Constitution, which declares that "railways heretofore constructed, or that may hereafter be constructed in this State, are hereby declared public highways, and railroad companies common carriers." The coupling together of these two predicates in one proposition assists materially in ascertaining its true meaning. Of course the railroad is not the same kind of a public highway as is the sea, the lake, the river, the canal, the common road, the turnpike, or the street. Neither are any two of these exactly of the same kind, but they are all highways, and adding the railroad to the list, we may affirm of them all—that the citizen is entitled to use upon any one of them whatever mode of transportation may be adapted to its peculiar nature and characteristics, and consistent with the rights of others, or the public welfare. On the street, the turnpike, or the common road he may use for the purpose of locomotion, either his own physical powers or those of any domestic animal, or any mechanical power that does not interfere with or endanger the rights of others; or he may use the vehicles of common carriers running upon these thoroughfares. So, in a more restricted sense, perhaps, as to modes, he may use all aquatic thoroughfares, and with still other restrictions he may use the railroad. In all cases the use is his, subject to such restrictions as, from the nature and characteristics of the thoroughfare, are consistent with the safety and rights of others, or in other words, with the public welfare. He may and he does put upon the railroad his own coach or his own freight car, and demand that for a reasonable compensation the same be hauled by common carriers operating motive power on that line; or he may and he does offer himself or his goods for transportation in the coaches or cars of any common carrier using the line with the vehicles he requires. He may also enter upon the railroad with his own motive power, but in that case in order that he may not imperil the safety or rights of others, he must place himself under the direction of the officer controlling the movement of trains, and implicitly obey his orders.

These are some of the rights which the people have in the railroad, because it is a highway, and we have assumed it to be a highway, because it is so declared in our State Constitution. But if it were expedient to go behind the Constitution, and discuss the question of the *de facto* status of the railroad company in the body politic, and the tenure by which it holds its property, etc., we think it can be clearly demonstrated that all, and more than all the rights we have enumerated belong rightfully to the public, and that the railroad is a highway in fact as well as in law. The railroad company is a corporation, of the non-political or private class, in the form of an incorporated joint stock company, organized for the sole purpose, on the part of the incorporators, of pecuniary profit to themselves; and they solicit the privilege of incorporation, because under it each one of them can invest a portion of his capital in the contemplated business, without jeopardizing the remainder, which he cannot do in an individual or an ordinary

partnership undertaking. This encourages the investment of capital in the projected enterprise, and in order to justify the granting of this privilege, or in other words, to make it consistent with the ancient legal maxim that "All corporations are supposed to be created for the public good," it is necessary to assume that the business enterprise thus encouraged is in itself a public benefit. The application of this rule opens the question whether we have not been too reckless in the creation of business corporations. But in respect to the railroad, this question is not raised. That it is a public benefit is not disputed, but on the contrary most freely and liberally acknowledged. Under the laws of this State any five persons can organize themselves into a railroad company, and by paying into the State Treasury one-tenth of one per cent on the first $50,000 of its capital stock, and one-twentieth of one per cent on the remainder, they can construct and operate a railroad between any two points within its limits, and any real estate that may be necessary for this purpose may be therefor appropriated without the consent of the owner, and for a consideration not agreed to by him, precisely as in the case of other highways; and this exercise of this State's right of eminent domain in its favor, of itself alone, most unmistakably stamps upon the railroad an indelible mark, to be found nowhere else than on public property, and which furnishes the ever present and conclusive evidence that it is a public highway. No one now dare affirm that private property can be taken for other than public use; and in all cases where the use is apparently private, or in part actually so, there is outside of that a much greater public good, or the seizure cannot be sustained in equity. Moreover, we authorize the railroad company to issue its capital[2] stock to an amount equal to its entire cost of construction and equipment, and its mortgage[3] bonds to an equal amount more, so that if its corporators have been competent to conduct the enterprise undertaken by them, and have built a road that can earn a good interest on its cost, they can at its completion, mortgage it to the full amount of its cost, sell the bonds at par, pocket the proceeds and the road will have cost them nothing, except the pittance paid into the State Treasury and the use of the money during the time of construction.

We have, therefore, literally *given* to the companies whatever of private ownership there may be in the roads, and in addition to that we have given them most liberal subsidies from the public funds. To all these favors they are legally entitled, and practically they have realized much more. It is preposterous to suppose, it is an insult to the intelligence of the people, and a denial of their capacity for self-government, to assert that all this most extraordinary liberality has been exercised toward the railroad companies, and towards them alone of all persons either natural or artificial, without an intended and expected corresponding public benefit. There being nothing left in this case for the people to enjoy except the *use* of the roads, it follows that the public use of the railroads, in any mode or manner consistent with the general welfare is the grand benefit expected to result from their construction, and the will of the people in respect to them is but modestly expressed when formulated, in the Constitution of 1875, into the

2, 3 See Section 727 and 765, R. S.

declaration above quoted. Evidently they are entitled to all that this declaration implies; the equal rights of all in terminal and transportation facilities should be most sacredly guarded, and as other highways created by any public authority can be abolished only by the same authority, so this highway created by the State, can be abolished only by State authority.

The railroad company stands before the public in the double capacity of the authorized owner of a thoroughfare and of a common carrier. In the former capacity it is similar to a canal, a turnpike or a bridge company, each of which owns a thoroughfare and collects tolls from all who use it, and in the latter capacity it belongs to the same class as the owners of packet lines and ferry boats, of stages, hacks and drays, who charge their customers according to the service rendered. As to canals, turnpikes and bridges, the universal practice is to limit the tolls upon them either in the charters of the companies or by general laws. If this were not done, their owners could, by exorbitant and discriminating charges, not only impose grievous and unequal burdens upon the people, but they could utterly annihilate the public highway feature in these thoroughfares, and it is to prevent this that tolls are limited by law. This being done, the free competition between a multitude of carriers along each one of them, and all accommodating the same points upon them, would seem to render any statutory limitation of carriers' rates unnecessary. Nevertheless, this restriction is frequently imposed, and as if to show that the right of the law-making power to restrict carriers' rates is absolutely indisputable, it is most frequently done in the very case where competition is the most free, most active and most persistent, viz.: in the case of hackmen on the streets of a city. If it be necessary to so carefully guard the public interest against the evils necessarily resulting from private ownership in public thoroughfares, and against the greed of carriers, in these less important cases, where the injury would be in each case so slight, and would be felt by so few people, it certainly is much more necessary in this case where one particular kind of thoroughfare controls the inland transportation of the entire commonwealth, and affects the cost of living of every family within its limits; a highway upon which one and the same party collects both the tolls for the use of the road and the pay of the carrier, and has, in practice, excluded the total benefit of a general competition and converted a partial one into a positive evil. That the public mind apprehends the dangers of the situation and would guard against them is made evident by the statutes intended to prevent combined ownership in competing lines; and that it regards the regulation of rates as essential to the preservation of the public highway feature in railroads is unmistakably indicated in the very section of our Constitution which declares them to be public highways, the whole of which reads as follows:

"Railways heretofore constructed, or that may hereafter be constructed in this State, are hereby declared public highways, and railroad companies common carriers. The General Assembly shall pass laws to correct abuses and prevent unjust discrimination and extortion in the rates of freight and passenger tariffs on the different railroads in this State; and shall from time to time pass

laws establishing reasonable maximum rates of charges for the transportation of passengers and freight on said railroads, and enforce all such laws by adequate penalties."[3]

If the question be asked, why did we ever grant in special charters to railroad companies the right to fix rates by their directors, we reply that a full and complete answer to this question was made on page eleven of the Report of this Board for 1878, and if that be not deemed satisfactory, we add that at the time these charters were granted the unanimous opinion of the civilized world was, that railroads were merely improved highways, and that competing carriers were to be allowed on each line.

That accounts for the non-restriction of carriers' rates, but not for the failure to limit the tolls for the use of the road, in respect to which it may be said that the liberal spirit manifested in this concession is of the same character as that shown in other legislative enactments upon this subject, and particularly in the munificent subsidies granted for the purpose of securing the use of railroad transportation facilities, which liberality cannot be used in argument against the rights of the people, and does not prove that the Legislature would if it could, or could if it would, barter away the public interest, or in any way restrict the people in their right to use these transportation facilities in whatever mode or manner may be consistent with the general good. We are therefore unavoidably forced to the conclusion that railroad companies are not only subject to all restrictions applicable either to private owners of public thoroughfares, or to common carriers, but that as they alone exercise the functions of both, they form an exceptional class, requiring peculiar and exceptionally stringent regulation.

THE CREATORS OF THE AGE OF STEEL.

BESSEMER, SIEMENS, WHITWORTH AND GILCHRIST.

There is more of truth than poetry in giving to the century beginning with the year 1850 the name of "The Age of Steel." The metallurgical inventions and discoveries which mark abruptly that period have effected a revolution in the industry of the world. Steel is to us what iron was to our grandfathers; what bronze was to the armies that sat in league before Troy; what stone was to the naked savages that dwelt in the caves of Gaul before the beginning of history. The very web and woof of modern civilization is woven out of steel. The production of steel in 1882 was as great as the crude iron product of 1850. The metal is omnipresent; it has replaced iron, wood, brass and copper. The rails, ships, cannon, and machinery of the world are steel. The best definition yet given of man is that he is a tool-using animal; his tools are steel, and the tools wherewith he makes his tools are steel.

As Carlyle says, "We are to bethink us that the epic verily is not Arms

3 Article 12, Section 14.

and the Man, but Tools and the Man—an indefinitely wider kind of epic. Man is a tool-using animal. Weak in himself and of small stature, he stands on a basis, at most for the flattest solid of some half-square foot, insecurely enough; he has to straddle out his legs lest the very wind supplant him. Feeblest of bipeds! Three quintals are a crushing load for him; the steer of the meadow tosses him aloft like a waste-rag. Nevertheless he can use tools, can devise tools; with these the granite mountain melts into light dust before him; he kneads glowing iron as if it were soft paste; seas are his smooth highway; winds and fire his unwearying steeds."

The conquest of the world man is achieving with steel, and who the men were that have put this weapon in the hands of man, Jeans tells us in the book whose title precedes this article.

The two first and greatest inventors in the trade reaped no reward. Dudley in 1618 learned a way to smelt iron with coal, and died in obscurity. Henry Cort, in the middle of the eighteenth century, invented the puddling process, and would have starved but for a pension of £200 given him by Pitt. Honors and wealth, however, were showered lavishly on the bright galaxy of men whose names are enrolled in the list of the creators of the age of steel. The story of their triumphs over matter and circumstance makes one of the most interesting chapters in the history of industry.

Sir Henry Bessemer.—Among the French refugees driven to England by the Terror was Anthony Bessemer. A learned and able man, he speedily accumulated a handsome property, the reward of an inventive ingenuity inherited and developed by his illustrious son. Among many other profitable processes the elder Bessemer discovered that an alloy of copper, tin and bismuth was the best for type metal. His process he kept secret, claiming that the superiority of his type came from the angles at which it was cut. It lasted twice as long as the other types, and sold all over England. The youngest son of this gentleman was Henry Bessemer, born at Charlton in 1813. His first attack upon destiny was made in improving the stamps upon public documents. He invented a stamp which could not be duplicated or detached, which was adopted by the Government, and for which not a penny was ever paid the young inventor. His next work was a machine for making patterns of figured velvet, a type-casting machine and a type-composing machine. While working upon this latter machine he was struck by the fact that bronze powder when manufactured sold for 12 shillings a pound, while the raw material cost but 11 pence. The difference he knew must come from the process of manufacturing, a process which he at once began to study. The article came altogether from Nuremburg in Germany, and no one in England could tell him how it was made. For nearly two years he studied this problem, earning success in the end by his infinite industry. He had not learned to have confidence in the patent laws, and he determined to keep his invention a secret. A friend advanced him £10,000, works were erected, the machinery being made in different parts of England. Five operatives were employed, at large salaries, under pledge of secrecy, and the bronze was turned

out at a cost of less than 4 shillings a pound. To this day, although forty years have elapsed, no one has surprised this secret. Sir Henry Bessemer has years since rewarded the faithfulness of his workingmen by giving them the factory and the business, and they too, have made fortunes out of the trade.

Between 1844 and 1850 Bessemer patented machines for the manufacture of paints, oils and varnishes; for the separation of sugar from molasses; for a drainage pump capable of discharging twenty tons of water per minute; a machine for polishing plate-glass, substituting a vacuum for the plaster bed. Each of these was meritorious as unique, and as profitable as they were ingenious.

This much will show the surprising versatility of the man, and enable the reader to grasp the character that revolutionized modern industry.

The Crimean war turned Bessemer's attention to ordnance, he produced a projectile which rotated without the aid of rifling from the gun, and made many improvements in the guns themselves. The English authorities ridiculed his improvements, the Emperor Napoleon was greatly struck with them and requested Bessemer to continue his experiments at the expense of France. At one of the subsequent tests Commander Minie said: "The shots rotate properly, but if you can not get a stronger metal for your guns such heavy projectiles will be of little use." That remark produced the Bessemer process for making steel. He knew nothing, absolutely nothing, about metallurgy; he had no idea how any improvement was to be made, and yet he resolved to attack this problem of steel making and solve it.

Prior to 1740 the best steel was made in Hindostan, and cost £10,000 a ton. A watchmaker named Huntsman, after a long course of experiments in that year, produced equally good steel, which could be made at £100 a ton, and for a century Huntsman's process had been used without improvement. In the English process before 1740 the bars of iron were heated with a cement of hardwood charcoal dust, which added carbon to the metal, and made what is called "blistered steel." The heating had to be continued several days. This was as yet unfit for forging and the bars had to be broken into lengths of about eighteen inches, raised to a welding heat and hammered with a "tilting hammer," a process which produced good steel. Huntsman took the blistered steel, broke it up into bits, and put it into crucibles with coke dust, fused the whole, and so made cast steel.

When Bessemer began his work this process was the only one in use. The iron had first to be melted into pigs, the pigs heated with carbon into blistered steel, the blistered steel broken up and re-melted with carbon into steel ingots in crucibles which could not hold more than thirty pounds each. Bessemer's experiment produced first a cast iron better and stronger than any known before.

At the end of eighteen months the idea struck him of rendering cast iron malleable by the introduction of atmospheric air. A great many experiments followed, all of them moderately successful. Mechanical difficulties almost insuperable stood in the way. At last he constructed a circular vessel three feet in diameter and five feet high, able to hold 700 weight of iron. He bought a pow-

erful air-engine and ordered in a quantity of crude iron. This was a Baxter House, a place to be ever memorable in the history of the steel trade. The apparatus was ready, the engine was forcing streams of air into the openings in the fire clay-lined vessel, and the stoker was told to pour in the iron as soon as it was sufficiently melted.

The metal was turned and a volcanic eruption ensued; such a blaze of dazzling fire was never seen in a work shop before. Corruscations of fire filled the chamber. The metal flowed down and the air burst through it upward, breaking away in great bubbles of living glory. A pot-lid hanging over the blaze disappeared in the flame. All this time the air was rushing into the molten mass and no one dared to go near to shut it off. While they were debating the flame died down. Soon the result of this wonderful pyrotechnic could be examined. It was steel! Seven hundred weight of steel made from the melted pig without crucible, coke dust, or charcoal. Seven hundred weight of steel born simply of fire and air!

The British Association met in the following week, and Bessemer read a paper describing his process, exhibiting at the same time his results. It was on the 11th day of August, 1856, that this public announcement was made of the new method. The whole industrial world was aroused by the tidings. Bessemer's paper was reproduced in the *Times*, and the iron trade examined the discovery with infinite interest. Experiments were made in a great many foundries, and the sole talk of the hour was the new way of making steel. Within three weeks after reading his paper at Cheltenham, Bessemer had sold £25,000 of licenses to manufacture under his patent. The Dowlais Iron Company was the first to begin the manufacture. Bessemer personally directed the construction of the works. Again the molten iron was poured into the receptacle, again the air blast bubbled through the metal, the gorgeous display of Baxter House was repeated, everything went well, but the result was not steel—it was nothing but a very good cast iron.

Those who had praised the new process now ridiculed it. The failure was inexplicable, but it was a failure, and exactly six weeks after the publication of the article in the *Times* a meeting of iron-masters at Dudley condemned the Bessemer process as a practical failure.

The inventor was not dismayed. Patiently and hopefully he set to work to find the flaw which had spoiled his work. A long series of experiments followed before he found the cause of his failure. By mere chance the iron used on the occasion at Baxter House, when steel was made was Blænavon pig, which was exceptionally free from phosphorus. The metal used at the Dowlais works contained this element. Here he found the cause of his failure. He set to work to eliminate the phosphorus by the puddling process, but while doing this there arrived an invoice of Swedish pig iron, clear of the obnoxious substance. Under his original process this yielded steel of such a high quality that he at once abandoned the effort to dephosphorize ordinary iron and began to manufacture from

the Swedish import. Sheffield steel was selling at £60 per ton; he could buy Swedish pig for £7 and turn it into steel at a very small cost.

Steel is pure iron with a small percentage of carbon to harden it. The line of demarcation between steel and iron is a difficult one to trace. Following the discoveries made in India by J. M. Marshall, Bessemer introduced ferro-manganese into his cenverter and the pure iron was at once carburized into steel.

The public, however, had lost confidence in Bessemer; he had spent his private fortune, he had made steel, the point was now to sell that steel. Through the assistance of Mr. Galloway, Bessemer bought in the licenses which he had sold, works were erected, and steel produced at a profit at £42 a ton—Sheffield was selling at £60. This argument was unanswerable—the Bessemer process had won, the iron-masters took out licenses under it and the age of steel began.

The revolution spread over Europe and America; the process was especially popular in Sweden, where the Crown Prince superintended its first trial. In Prussia Herr Krupp, the great cannon-maker, agreed to pay Bessemer £5,000 for a license. With Bessemer's papers Krupp applied to the Government for a patent, the patent was refused, and no royalty was ever paid to the inventor. Belgium and France appropriated the new process, and declined to recognize Bessemer.

Bessemer had attacked the problem of making steel for the purpose of having a better gun-metal than any then existing. Accordingly he returned to his experiments with ordnance. Steel cannon were cast with a tensile strength of thirty tons to the square inch, figures much greater than had been reached before. A number of tests were ordered at Woolwich, but through rank favoritism the matter was submitted to Sir William Armstrong, a rival cannon-maker, and very naturally an adverse decision was rendered. The Government would not touch the new metals, and Bessemer for the time being let the matter pass, concentrating his attention upon the industrial uses of steel, a field large enough for the ambition of any man. In 1861 he induced the London & Northwestern Railroad to put down some steel rails as an experiment. In 1881 these rails were still in good condition—iron rails had to be turned once in nine months. The next step was the substitution of steel for iron in ship-building; the next, an invention of steel projectiles, which were found to penetrate the iron armor of ships as easily as the old iron balls went through wooden vessels. At this time Bessemer was receiving £100,000 a year from his business, but his inventive faculty was not let lie dormant. The best known of his later devices was a ship built with an automatically balanced cabin in order to do away with sea-sickness. This was a theoretical success, but a practical failure. Henry Bessemer's life-work was the production of steel from cast iron; all the other many achievements of his mind were, after all, but side issues. In the first twenty years of the life of his invention he had saved to the industry of the world over a billion pounds sterling—that is, the work of one man did nearly twice as much to build the wealth of the world as the American civil war did to pull it down—indeed, figuring upon the actual saving made, Bessemer's invention had saved enough money to humanity

by 1882 to pay for the American civil war, the Franco-Prussian war, the Austro-Prussian war and the Italo-Franco-Austrian war of 1859. The inventor had been made a knight of the Order of Francis Joseph, he has been given the Grand Cross of the Legion of Honor, but the British Government declined to permit him to accept it. Out of the enormous benefits of his invention there has come to the inventor a fortune for himself. When his patent expired in 1870 he had been paid in royalties £1,057,748. Added to this, his Sheffield works divided in profits during their fourteen years' existence fifty-seven times the original capital, and the works sold for twenty-four times the original capital. In 1879 Bessemer was knighted by the Queen; honors were showered upon him. His services to humanity were recognized at home and abroad. All of the great cities of Europe conferred their freedom upon him, and, what caused the utmost pleasure to the inventor, a town in Indiana whose chief industry was based upon his invention was named for him, assuring him the only immortality that he desires —the constant record of his memory among the men for whom he worked.

Sir William Siemens.—Next to Sir Henry Bessemer among the creators of the age of steel stands Sir Charles William Siemens, who was the philosopher of the new era as Bessemer was the inventor. After becoming a thorough student in electricity, Siemens' first exploit which attracted general attention was the invention with his brother of the system of anastatic printing, a process by which any old or new printed matter could be reproduced. This was rather a *success d' estime*, than a money-making discovery, although it brought the young inventors into European notoriety. The method consists in applying caustic baryta to a page of printed matter, changing the ink to a non soluble soap, and then applying sulphuric acid to precipitate the stearine. The paper was then pressed into a slab of zinc, making an intaglio from which copies could be easily taken.

Siemens next perfected a method for greatly increasing the heating power of furnaces by compressed air, the results being of immense practical value to the trade. The very high temperature which he was thus able to gain, at a small cost of fuel, naturally was applied to the working of steel. His method is called the "open hearth process." In this process the charge consists of pig iron, which is placed on the bottom and around the sides of the furnace. Melting requires four or five hours, then the pure ore is charged cold into a bath in quantities of four and five hundred weight. Violent ebulition ensues, and when this ceases more ore is put in, the object being to keep the boiling uniform. Spiegeleisen or ferro-manganese is added and the charge is cast. The result is steel. Siemens' first improvement was a rotating furnace, in which coal and iron are put together, and mixed and heated so thoroughly that the result is all that could be desired. So thorough is the process that the hitherto irreducible iron-sands of New Zealand and Canada can be worked to a great profit.

Coming into direct competition with the Bessemer product the open-hearth steel has held its own, its consumption in the United Kingdom rising from 77,500 tons in 1873, to 436,000 in 1882. The Lindore-Siemens Company rolls the armor-plate for the British Admiralty, and the steel has been found to be even

better than the Bessemer for general ship-building. In 1883 one-fourth of the total tonnage of new ship-building was built of Siemens steel.

Sir Wm. Siemens and his brother, Dr. Warren Siemens, of Berlin, have been called the pioneers of modern electrical research. The dynamo-machine is theirs, and much of the development of the electric light. Henry Siemens has put on record a series of experiments in electro-horticulture, which show astonishing results. In the hostile English climate he has produced ripe peas by the middle of February, raspberries on March 1st, strawberries February 14th, grapes March 10th; bananas and melons showed similar results.

The German electric railway is one of the enterprises of the Siemens. They are the builders—the creators—of the Indo-European telegraphs, reaching from London to Teheran, in Persia. The history of this enterprise, with its dangers braved and its difficulties overcome, is one of the most interesting of this interesting book.

The Siemens laid the first submarine cable in 1847 from Deutz to Cologne, covering their wires with gutta percha. The services of Sir Wm. Siemens to science as well as to the useful arts can not be too highly appreciated. Beside his industrial triumphs he reconstructed our theory of heat. Wealth and honors came to him, but in the midst of his career he was cut down. An accidental fall on a London pavement, November 5, 1883, ruptured the nerves of his heart and he died a fortnight later, his death being mourned as a national loss in England and Germany.

Sir Joseph Whitworth.—Joseph Whitworth's first industrial exploit was the production of true plane surfaces in metals automatically, an achievement perfected in 1840. The old method was grinding with emery powder and water. He planed the metals with a steel plane. "So exactly can surface plates be made by his apparatus that if one of them be placed upon another, when clean and dry, the upper will seem to float upon the under, without being actually in contact with it, the weight of the upper plates being insufficient to expel except by slow degrees the thin film of air between their surfaces. But if the air be expelled the plates will adhere together, so that by lifting the upper one the lower will be lifted along with it, as if they formed one plate."

Whitworth was essentially a tool-maker. No sooner had he perfected the plane with its immense effect upon English industry than he attacked the screw. His system of screws is now adopted all over the civilized world. Following up his improvements he recognized the necessity for a more exact measuring machine than any then in existence, and supplying this want he devised a machine which would measure distinctly and practically to the 40,000th part of an inch, and theoretically to the 1,000,000th. To show to what exactness this was brought we quote his own words in an address at Manchester in 1857. "Here," said he, "is an internal gauge having a cylindrical aperture .5770 inch diameter, and here also are two solid cylinders, one .5769 inch and the other .5770 inch diameter. The latter is .0001 of an inch larger than the former and fits tightly

in the internal gauge when both are clean and dry, while the smaller .5769 gauge is so loose in it as not to appear to fit at all. These gauges are finished with great care, and are made true after being case-hardened. The effect of applying a drop of fine oil to the surface of this gauge is remarkable. It will be observed that the fit of the larger cylinder becomes more easy, that of the smaller more tight. * * * It is thus obvious to the eye and the touch that the difference between these cylinders of one ten-thousandth of an inch is an appreciable and important quantity, and what is now required is a method which shall express systematically and without confusion a scale applicable to such minute differences of measurement." The Whitworth gauges have been adopted by the Government as standards of measurement.

The accuracy in mechanical processes rendered possible by Whitworth's inventions bore its first fruit in a direction which the inventor little expected.

England was engaged in the Crimean war, and the Enfield rifle, a hand-made weapon, was the arm of her forces. It became necessary to have these guns in large quantities, and the burning question of the hour was how to make these rifles by machinery. The science of projectiles was then entirely empiric. Some guns shot well and some shot ill, but why these were good and those bad no one knew. Whitworth went before a Parliamentary committee, and told it that until the data of rifling were established good machine-made guns would be impossible. It was necessary to find out what made an effective gun by continued experiment before anything else was done.

England needed a million rifles. To make these by the processes then in use would have taken Birmingham twenty years. It was agreed that the Government should bear the expenses of Whitworth's experiments.

A gallery was set up at Rusholme, 500 yards long, furnished with tissue paper screens in order to track the bullets throughout their flight, and with sliding targets. The experiments began in March, 1855. The Enfield rifle had a bore of .577 inch and the rifling had one turn in 78 inches. The first result was that in every particular the Enfield was found to be wrong. Whitworth made barrels with one turn in 60 inches, one in 30, one in 20, one in 10, one in 5 and one in 1 inch. To be brief, he determined conclusively that the best rifle had one turn in twenty inches, a minimum diameter of forty-five inches, and a rounded hexagonal instead of a circular bore. After beating all other guns at short ranges the Whitworth rifle had a deviation of about 4.62 feet at 1,400 yards. The Enfield could not hit the target at all. With a steel bullet Whitworth's rifle perforated plates of iron half an inch thick at an obliquity of fifty degrees, and easily passed through thirty four half-inch elm boards.

Applying the same principles to artillery, Whitworth devised a gun which threw two and one-fourth hundred weight of iron six and a half miles.

To such a great superiority did he bring artillery, first by his invention of compressed steel, next by making the guns breech-loading, and finally by increasing the size of the powder chamber, that it began seriously to be doubted whether any armor could be made able to resist the crushing force of the square-headed

Whitworth projectiles. Whitworth himself attacked the new problem and in 1877 prevailed. He made plates of compressed steel, built in hexagonal, each of which was composed of a series of concentric rings around the central disc. The rings prevented the spreading of a crack beyond the one in which it occurred. Of this material a target was composed nine inches thick, supported by a wood backing against a sandbank. In front a horizontal iron tube was put to receive the fragments of the shot. Against this target a Pelliser shell, weighing 250 pounds, was fired point blank from a nine-inch gun, with fifty pounds of pebble powder, at a distance of thirty yards. This shell would have passed through twelve inches of ordinary armor; against the new target it was shattered into innumerable fragments. The target was drawn back eighteen inches into the sand. The fragments of the projectile escaping at the end of ten tubes continued their rotation in such a manner as to cut through the planks in front of the displaced target. The only piece that survived the shock was a flattened mass of eight pounds, formed from the apex of the shell and left imbedded in the target, where it had made an excavation of eight inches in diameter, and four-tenths of an inch deep in the deepest part. The ring which received the shot was not cracked.

This experiment alone effected a revolution in naval armament.

There is not room here to speak of Sir Joseph Whitworth's eminent services to the cause of technical education. He has devoted a large part of the great fortune won by his inventive genius to the founding of schools and scholarships for the benefit of young men desiring to explore the wide field of mechanical industry.

SIDNEY GILCHRIST THOMAS.—It will be remembered that the Bessemer process failed after its first success, and that the reason of that failure was the presence of phosphorus in the pig iron. Such an insuperable obstacle did this present that Bessemer gave up the problem and went to Sweden for his pig. To Mr. Sidney Gilchrist Thomas belongs the honor of discovering a means for getting rid of this obnoxious element. Acting upon his idea, he and his cousin Mr. Gilchrist, the first twenty-six, the latter twenty-five years old, conducted an exhaustive series of experiments to find a base with which phosphorus would unite. A base is the name given in chemistry to any element for which an acid has affinity. At last they made bricks of lime and magnesia, which they subjected to an intense white heat, when they became hard as flint. With these bricks, which were a base, they lined their converters, the melted pig iron was poured in and the phosphorus at once left the metal and attached itself to the bricks. A quantity of lime is added to the run, and the result is a thoroughly dephosphorized iron.

The news of the new process spread through Europe, and to show how greatly the invention was appreciated the following circumstance is detailed. A continental iron-master called on Mr. Thomas at 7:30 one April morning to arrange for terms for the use of the patent. Just as they were concluded a telegram was handed to Mr. Thomas stating that another iron-master from the same

district was coming to arrange terms. The first visitor had secured a monopoly and the second man was too late. Both of the iron-men had come over on the same boat; one had driven straight to the patentee on landing, the other had gone to get his breakfast.

Before the process was three years old it was the means of producing half a million tons of steel per annum.—*Globe-Democrat.*

THE ISTHMUS CANAL.

Mr. Theodore H. Growney, a practical engineer, who has been for two years employed on the Panama canal, has returned to San Francisco, and gives a rather discouraging account of the work. He says that there has been an enormous expenditure of money without any commensurate results. Every step taken in the prosecution of the great enterprise has been characterized by prodigal waste and inconceivable mistakes. The company spent a large sum of money in building up the town of Colon, at the Atlantic terminus, which should have been devoted to digging the ditch. The town would have grown of itself with the progress of the work. It is essentially French in its architecture, population, language, and, in fact, in all its characteristics.

The first division of the canal extends from Colon to Gatun, seven miles. It was supposed that all the digging on this division could be done with dredging machines, and the contracts were made accordingly. At the end of two miles, however, the machines struck a coral reef, whose existence was not suspected, and they could do nothing more until a passage was cut through the reef. The dredges were floated over the obstruction at high tide, but the canal has not yet been cut through the coral. The machinery is wearing out, and a great deal of money will have to be expended in replacing it before much effective work can be done.

The second section extends from Gatun to Palo—four miles—and runs through rocks, alternating with swamps and jungle. Nothing has been done on this section yet except to clear away the surface obstructions, and consequently not much money has been spent. From Palo to Fijole the line of the canal has been marked by clearing away the timber and leveling the hillocks. The ditch must be dug through red clay and rocks. A good deal of money has been expended in making roads for carrying the dirt to dumping places. About $4,000,000 has been expended in preliminary work between Fijole and Chagres.

Mr. Growney goes over the whole twelve sections and gives the condition of each, and the summing up of the whole is anything but encouraging. Colossal blunders have been made in the original estimates which put the costs far beyond anything that has yet been conceived of. Up to June 28, 1884, according to the engineer's estimates, $50,000,000 had been expended. The route through the Emperador section was changed after $3,000,000 had been wasted in experimental work.

The most extraordinary blunders seem to have been made by Count de Lesseps himself in his estimates. For instance, De Lesseps contemplated a perpendicular cut on the Culebra section 283 feet deep. It has been ascertained, however, that the banks must have a slope of at least fifty-four degrees, and this will involve the removal of many millions of cubic feet of earth over and above the amount contemplated in the estimates. The cost of this cut was fixed at $10,000,000, but it will exceed $20,000,000.

Mr. Growney has no hope that the canal will be completed within the century, and he says that if De Lesseps were to die the whole project would collapse. —*National Republican.*

EDUCATION.

SCHOOL AND STATE.

C. W. STEVENSON.

In the midst of a great political conflict like the present, when all governmental policies are discussed throughout the land, the great underlying principles should not be forgotten. The theories of parties should not blind us to the fact that American life is full of crying evils and that in the thoughtful mind grave fears arise as to the ultimate result of free government. What are the needs of the hour, and whither are we tending?

The past shows that governments by the people have been of short duration. Democracies have been their own destroyers, and the history of the rise, progress, decay and fall of the Grecian and Italian Republics is but the mournful story of the enervation of prosperity, the triumph of party over principle, and of a venal populace made the prey of despotic chieftains from without and of ambitious leaders and false patriots from within. It is the boast of the nineteenth century that the past one hundred and eight years of American independence has at last demonstrated the beneficence of a government by the people and for the people. We behold with pride the stretch of empire having for its heart the matchless valley of the Mississippi; we love to gaze upon the material wealth and architectural splendor which everywhere greet the eye; and the glory of our educational institutions, our religious and political liberty, the purity and protection of our laws, and the peace which we enjoy with all the world, together, render the words "I am an American citizen," the proudest utterance vouchsafed to man. But the forces which under an intelligent administration of popular rule serve to maintain a Republican form of government, misguided, become surcharged with evil, and the immediate cause of its downfall. And if we but look a little deeper into the workings of the system under which we live, we will find

that there *now* are dangerous tendencies in American life which are indeed alarming. There are clouds in the national sky, white and high sailing, now perhaps, but which if lowered must spread havoc and ruin among the ranks of men.

In the evening of the nineteenth century we are abreast of the experience of the world through all the past in the forms of government and yet there are those among us who believe in a limited monarchy. In a government where the people are the sovereigns we see ignorance among the masses. Super-refined ideas of liberty are endangering that freedom which is the servant of law. Abstract speculations concerning the rights of property, in the hands of the uneducated, would unsettle all the laws of the ownership of lands. The landing of the Mayflower has become almost a myth and we have drifted so far from the policies and practices of the pilgrim fathers that not a popular election passes without witnessing the priceless ballot made an engine of corruption. The laborer is protected in his life, liberty and property, and yet with the granaries of the world from which to draw our sustenance the red hand of commission has been thrust more than once in the face of the law. With cereals rotting in the sun, values are inflated. In the multiplicity of our industries, vocations await the choosing, and yet capital is as merciless to our poor as an Egyptian taskmaster to the creeping drudges that built the Pyramids by the Nile. With millions of tons of coal and iron from which to manufacture the machinery of the world, thousands of hoarse throats are demanding an increase of wages, and the tramp is abroad in a land of plenty. The freedom of the press, established that the purest ideas of the best men might stir a patriot's heart in time of peace, is now used to engender party spirit, and sends forth the stories of the blackest crimes upon the wings of the wind. There is profligacy and theft in high offices, patronage and spoils have become the object of success, and the highest gratifications are sacrificed upon the altar of party-supremacy. Religious freedom is guaranteed to everyone, but the speculations of pseudo-philosophers threaten vitue itself, and would have us disregard civil to say nothing of sacred laws. Social laws are being disregarded. Divorce threatens the institution of the home, and, polygamy-like, a canker grows upon the heart of the body-politic. Reforms, the delirium of an hour, sweeping with the rapidity of a prairie fire, serve only to dry up the heart. Materialism and Agnosticism threaten to loosen the soul from even its moral moorings. A mad death-dance of new ideas unsettles all belief. A feverish unrest has taken possession of the people, and the accumulation of wealth is made the sole end of living. Aristocracies are growing and every decade more firmly establishes Plebeian and Patrician castes. Luxury, ease, effeminacy, fashion, ostentation, the pursuit of pleasure, title and rank and gold, are the moving spirits of existence, and the centralization of power, the despotism of ambition, and the oligarchy of wealth threaten the stability of our institutions.

The Parthenon and Panthenon are but the melancholy monuments of a glorious liberty lost through the same influences which are about us now. All the past is eloquent with the wrecks of nations. Shall we allow these insidious evils, and they are menacing evils if there are any parallelisms of history, to creep upon

us like the sleep of death? Every year leads us further from the ancient landmarks and increases our responsibilities.

> "Revolutions sweep
> O'er earth, like troubled visions o'er the breast,
> Of dreaming sorrow; cities rise and sink,
> Like bubbles on the water; * new empires rise,
> Gathering the strength of hoary centuries,
> And rush down like the Alpine avalanche,
> Startling the nations."

If we perish, it will be by our own hands, and the fate of the American Republic lies in the hearts of all the people. How then may we perpetuate this beautiful fabric? All the immortals who framed that wise compact, the Constitution, relied upon the universal intelligence of the people. Washington in his farewell address said: "Promote then, as an object of primary importance, institutions for the general diffusion of knowledge. In proportion as the structure of a government gives force to public opinion, it is essential that public opinion should be enlightened."

Much need then for the common school!

Here indeed is "a government which gives force to public opinion!" To do this is to make man a free agent, to give him the right to think, and to express his thoughts in shaping his own government. No stream can rise higher than its source. The ignorance of the one-man power, the king, has built the tyranny of the ages. Will a government founded upon the ignorance of the many be less fatal to the wants of man? Ignorance is slavery. It has forged every link in the chain of oppression since the world began. It has pressed down every thumb screw, revelled upon every rock and at every stake through all the dynasties of the past, reared its dark throne in the dungeon's cell. Education is liberty and light. *This* civilization is its most beauteous flower. It has built the cathedral dome and the hall of justice. It has steeled the brain and warmed the heart. One morning, not long ago, it touched its zenith. Reaching out, with sublimest wisdom into the infinite air above us, it caught the slumbering lightning there, and freighting it with America's sweet message of sympathy, flashed it underneath a thousand miles of ocean's brine to comfort a sorrowing mother's heart, the Queen, Victoria, mourning for the Princess Alice. Here is a government giving force to public opinion—shielded with an invincible constitution, that, strong in its provisions, beautiful in its symmetry, the ark of our political safety and the bulwark of our freedom, for over one hundred years has carried us on through storm and disaster and death to the infinite possibilities of the present. Much need then for the future of an intelligent people, of an enlightened public opinion!

A recent writer on the constitution says: "America, free, happy, and enlightened as she is, must rest the preservation of her rights and liberties upon the virtue, independence, justice and sagacity of the people. If either fail, the Re-

public is gone. Its shadow may remain with all the pomp and circumstance and trickery of government, but its vital power will have departed." Speaking further and pointing to their future he says: "In America, the demagogue may arise, as well as elsewhere. He is the natural, though spurious growth of republics; and like the courtier he may, by his blandishments, delude the ears, and blind the eyes of the people to their own destruction. If ever the day shall arrive in which the best talents and the best virtues shall be driven from office by intrigue or corruption, by the ostracism of the press, or the still more unrelenting persecution of party, legislation will cease to be national. It will be wise by accident, and bad by system."

Look about you! Even now the wheels of government are jarring. In a valley, before whose annual wealth-producing qualities, the valleys of the Nile, the Euphrates and the Amazon dwindle into utter insignificance, is heard in unmistakable portent, the cry of oppressive taxation. New parties, the mush-room growths of an hour, spring full armed with all the fatuous principles of immediate salvation into the arena of political strife. Designing leaders, with glittering pictures of sudden reform, whose throats are hoarse with preaching the miraculous deliverance of the dear people, are lashing the sea of popular feeling into waves of excitement, that threaten to loose us from all the revolutionary landmarks. Senates are disrupted over the appointment of a single officer. It is claimed that with all our boasted freedom we have no power upon the high seas, and less than our due prestige among the nations of the earth, and with all the civil questions that arise from the conflicting interests of fifty millions of people demanding a nicer adjustment, legislative bodies are thrown into fever-heat and days upon days of discussion over the re-instatement of some military chieftain.

And yet in a government where all good comes from the people, according to a late census, over five and a half millions of persons over the age of ten years could neither read nor write. Of our adult males seventeen per cent were illiterate and of our adult females twenty three per cent. Again, fifty per cent of all the criminals are deficient in education, and a high authority speaking of the United States says that "One-third of all the criminals are totally uneducated, four-fifths are practically uneducated, and the proportion of criminals from the illiterate classes is at least ten-fold as great as the proportion from those having some education."

Statistics further show that "the proportion of paupers among illiterates is sixteen times as great as among those of common education," and that an important relation exists between education and health. Think of it in a land where the ballot is the only king, the balance of power is in the hands of the uneducated. Our domain is wide, and in addition to our native illiteracy, thousands of the lower classes of other nations are crowding to the polls. Time was when there was only the East and the North, now there is the West and the South! Is self-preservation a less primal law with nations that with individuals? If public virtue and citizenship rest upon the education of the masses, should not the State

compel the education of her subjects? Surely the need of the present hour is a broad intelligence grounded in the hearts of the people.

We are all of us parts of the mighty whole. Your voice and my voice form a part in the destiny to come. Your vote and my vote help to frame the massive structure of our laws. Those who have gained the heights and are looking back upon the thousands yet toiling to reach the high plain of truth and virtue and knowledge should send all the succor of a strong government to aid them mount the steeps of ignorance. Storms are brewing. If the State do not educate the children, let her beware the hour of peril, when to their hands shall fall the reins of government. Spread wider the influence of the common school. Guard it with the strong arm of the treasury. Why, in the Congress just closed at least ten pension bills have been introduced and one important educational measure! See that the teachers of the child that is to bear the burden of the State are taught. Can the hand of a dauber paint the "Madonna" of Raphael, or the hand of a blacksmith chisel the "Minerva" of Phidias? We educate commanders of men at Annapolis and West Point; should the great army of pupils be without leaders that are trained? Certainly, he, who, from the State's point of view, says that the teacher can take the delicate tablet of the child's mind and write upon it the eternal characters of love and truth and knowledge without being a consummate artist, is a traitor to his country and unworthy the civilization which gave him birth.

If the abuses about us give rise to a wish for a limited power to control the operations of State, then it is evident that there are defects in our system. Let us educate more with reference to the State! Let the child lisp with its first numbers the words "Home" and "Country." From Kindergarten to University, teach the ethics of citizenship. Abstract mathematics will never make a patriot. Mere knowledge is cold, let it be more of a stepping-stone to an understanding of the laws of society. Better to be without grammar than without political economy. Teach the "Why" in history rather than the "How" and inculcate the lessons of peace rather than the lessons of war. Repeat ever and always the political story of the Revolution. Teach more of the laws of the land and speculate less about the inscructable laws of nature. If you dissect a flower or tell the sermon in a stone, teach also that all the bright infinity about us beats responsive to the heart of man with love and tenderness and truth. Crown the ever present "Now" with the gems of the good, beautiful, and true.

Under the present school system of the United States, too little attention is paid to the education of the citizen. We should begin early to teach of government and of our relation to the State. New men are acquainted with all the laws that environ them. Remember, that a large per cent of our school children leave school at the age of fifteen to enter the workshop and the store and to labor at the plow. If they do not learn here of the varied institutions of our government, is it true that they may learn without bias from the public hustings?

Oh, there are minds to be fed. Thousands have never yet seen the light of truth. The prince and the pauper are alike slumbering in our midst while arrant

politicians are weaving the warp and woof of destiny for the generations that are moving on to take their place. The child in the mine, and the child in the gas-lighted parlor, the child of the hungering beggar and the child of the devotee of fashion, the child on the high road to prison and the child climbing the convent walls, the child of the faro dealer and the child of the stock-gambler, whose homes are dark with poverty and want and toil, or rich with sparkling gold and bright with folly's ease, will never learn therein the duty which they owe to righteous law. With horizon lifted but a span, the shrunken circle of their lives is filled with self, and as the ship of state sails on, they laugh or curse, and little care who guides the craft, as long as freedom lasts and suns are bright and winds are fair, the puppets of designing men, the heavy freight of human dross.

Let not the State become a painted ship upon this painted ocean of moral degradation, indolence, ignorance, and political death. A little freedom may become a dangerous thing. You say that from the northeast there come the muttering thunders of a deadly war between Capital and Labor. Is it not possible to lift the one up to the softened tenderness of the other. If we could but teach those who control the millions of the earth the value of a single human soul, think you that capital would oppress the virtuous poor? But what, you say, can the State do? Religion alone can compass this Who can improve the mind when the body is racked with toil from morn till night? Can the State expect intelligence from its subjects when it does not provide from out the beautiful sunlight of heaven a single hour in the day when the groping mind may turn to science, or literature, or politics? Speed the time when the law shall lay its hand upon unfeeling wealth and say "the laborer is worthy of his hire;" respect thou the untutored child, and know that honest toil shall not be measured by the greed of gold. Let the State answer the question of the English Dickens, "Oh, ermined judge, whose duty to society is now to doom the ragged criminal to punishment and death, hadst thou never, man, a duty to discharge in barring up the hundred open gates that wooed him to the felon's dock, and throwing but ajar the portals to a decent life!"

The question of wages and wealth is paramount with us now. The inalienable rights of life, not passive animal existence, of liberty—not freedom of body but of the thinking soul to soar starward, of the pursuit of happiness—not to accumulate property, but to search with unwasting energy for the highest good—are threatened with destruction, and if the State does not preserve them whole and true, the doom of the Republican idea is sealed forever. Long ago, Charles Dickens, who from the dust in the highways of life searched out the pearls, wrote:

"If those who rule the destinies of nations would but remember this—if they would but think how hard it is for the very poor to have engendered in their hearts, that love of home from which all domestic virtues spring, when they live in dense and squalid masses where social decency is lost, or rather never found—if they would but turn aside from the wide thoroughfares and great houses, and strive to improve the wretched dwellings in by-ways where only pov-

ty may walk—many low roofs would point more truly to the sky, than the loftiest steeple that now rears proudly up from the midst of guilt, and crime and horrible diseases, to mock them by its contrast. In hollow voices from workshop, hospital, and jail, this truth is preached from day to day, and has been proclaimed for years. It is no light matter—no outcry from the working vulgar—no mere question of the people's health and comforts that may be whistled down on Wednesday nights. In love of home, the love of country has its rise; and who are the truer patriots or the better in time of need—those who venerate the land, owning its wood, and stream, and earth, and all that they produce? or those who love their country, boasting not a foot of ground in all its wide domain?"

The fault with our public school system is that we educate too much the mind and too little the heart. Freedom of religious worship does not forbid the State from becoming a great moral educator. It is because of this same want that the Nihilism of Russia is propagated by the students of the universities. And there can be no wonder at the mad resolve to exterminate the aristocracy and organize society anew, for there the serf has no voice in the national councils, no star of hope upon which to fasten his faith, nothing in the future but slavery or if he disobey the behests of the Czar, the mental and moral leprosy of a Siberian exile. But here the serf is a sovereign if the State can but point out the way. Teach them not only the duties of the citizen to the State but of the man to society.

This is pre-eminently an age of doubt. And when the State essays to educate, let it not be forgotten, that, "all private virtue is but public good." Shakespeare said:

> "There is a mystery in the soul of State
> Which hath an operation more divine
> Than breath or pen can give expressure to."

That mystery is the soul of man. Oh, who can tell what life is? Here—some "Little Nell" laughs sweetly in the sunshine, and whispers of love—there, the winds of winter are whistling keenly through the gray locks of some maddened Lear; here is a station of honor; there is a past of shame; here is a poet's statue in Westminster Abbey; there, somebody's darling is buried in a potter's field; here is the heroic patience of a broken heart; there, a plunge into the dark river; here, the lowly follower of the holy Nazarene; there, he who taking his burden for a pillow "lies down to dreamless sleep." Ah,

> "Happy the many to whom life displays
> Only the flaunting of its tulip flower;
> Whose minds have never bent to scrutinize
> Into the maddening Riddle of the Root,—
> Shell within shell, dream folded over dream."

The ocean of human life is never at rest. Between "two eternities," struggling against the bars of circumstance, striving to pierce the wavering gloom of the unknown, human life, faint with the oppressive environment, from the great

solitary deep of thought cries "whither and whence." Religion, like a sunrise upon storm-tossed waters, says "peace, be still," and hope nestles in the human heart. Science, with a loud voice, makes Reason say "thou knowest not," believe only in knowledge, and Doubt becomes the autocrat of the present. A great conflict is going on Sacred citadels of faith and creed are hard beset by the armies of reason and discovery.

Let not the smoke of the conflict cloud the vision. There are some laws of action true in the nature of things. *These, the State should discover.* The Republic of Rome fell with the fall of her gods. How many of the reckless lives about us stranded every day upon the rocks of crime, fall through the utter vacancy which follows in the track of materialistic and agnostic tendencies?

Robertson has said: "It is an awful hour when this life has lost its meaning and seems shriveled into a span; when the grave appears to be the end of all, human goodness nothing but a name, and the sky above this universe a dead expanse, black with the void from which God himself has disappeared. In that fearful loneliness of spirit, when those who should have been his friends and counsellors only frown upon his misgivings, and profanely bid him stifle doubts, which for aught he knows may arise from the fountain of truth itself; to extinguish as a glare from hell, that which for aught he knows may be light from heaven; and everything seems wrapped in hideous uncertainty,—I know but one way in which a man may come forth from his agony scatheless: it is by holding fast to these things which are certain still,—the grand, simple landmarks of morality."

More than eighteen hundred years ago there was born into the world a creed of love and duty saying—"love thy neighbor as thyself"—beside the purity of which, the codes of Confucius and Buddha, the Light of Asia, become but glittering baubles of oriental fancy. If it be not the province of the State to do more, while the "now" is being drowned in the wild search for the secrets of the future, then through all the net-work of the schools, let it lift high this banner, upon which is written in letters of light the word "Humanity." Then as Tennyson wrote:

> "Let knowledge grow from more to more,
> But more of reverence in us dwell;
> That mind and soul according well
> May make one music as before."

But the school is not the only agency by which the State may elevate the moral and intellectual tone. The prison and the hospital, the stage and the stump, the press and the public library may be made more ennobling. Look at your prison-houses! *There,* is need of radical reform. Now, they are great arsenals of trade. Hundreds are at work—a task unfinished, the lash or the blind cell follow. A half hour's religious service on Sunday at the muzzle of a repeating rifle, the only food for the soul. A government of fear! But read the mental transformation which Victor Hugo paints in the character of Jean

Valjean, who for seventeen years toiled as a galley slave for stealing one loaf of bread, and you will behold the demons which the State manufactures every day. Can you wonder that the convict goes forth with a hell in his heart, to prey upon his fellow? Wipe out forever the miserable doctrines that they should be self-sustaining, and tax the pure in heart that those who have committed the crimes may be shown the way of life, and inaugurate more of the reign of love.

Redeem the stage. Let virtue and peace beware when the populace applaud the scandals of life when rehearsed before the glare of the footlights. But the play has its audience no less than the pulpit. It may be made to touch the heart and generate noble aspirations when all else fails. Keep its teachings pure. Away with the tawdry representations of the hour when the terrible night-rider and the debauche of society are paraded before the public mind. Let character be the burden of the story recited, and orchestra, dress and scenery be but exquisite settings in which to present an ideal life.

Again, if we would have the ballot the potential factor in American politics, let the press above all other means of our popular education, banish from its columns the baneful evil of party spirit. Principles are the only vitalities which may organize men into parties. With the telegraph and the railroad, the press has become a household treasure, and the home and family are banned or blessed as its tone is pure and wise, or slanderous and unpolitic. Its freedom should not be compassed alone by the will of man, but rather by the will of the State.

This is the most "solemn experiment" in human government the world has ever witnessed. If there are abuses and neglects in government about us now, we should stay the tide while yet we may. If ignorance is an evil which forms a standing menace to good government, then look well to our schools and all the ennobling influences of our civilization. It is easier to tear down than to build up. A breath of tyranny, the revolution of a single day, the proscription of a single prerogative, may bear us swiftly to anarchy and ruin. The past remains unalterable. It is a "lighthouse in the great sea of time" and no act of ours can dim the lustre of a single star in the galaxy of the revolutionary heroism. But other generations will judge our work. We must account to the future for the "blessings which have been transmitted to us." Let us not "quench the light which is rising upon the world. Greece cries to us by the convulsed lips of her prisoned, dying Demosthenes; and Rome pleads with us in the mute persuasion of her mangled Tully." But if an enlightened people shall preserve the pure principles of our forefathers as a princely heritage to those of another day, what imagination can picture the ineffable glory that may surround the human mind in the century to come. To what liberation of soul, to what surpassing civilization, to what peace of government shall the world bow down. If king there be, his throne will tremble and the humblest peasant in far off Siberian waste will feel the thrill of life run through his soul, and if he shall but make the school and the press the arbiters of our destiny, perhaps soon will be realized Joaquin Miller's wondrous prophecy of the West: "The sea of seas shall rave and knock

at the Golden Gate, but this shall be the vineland, the place of rest, that the old Greek sought forever to find. This will be the land of eternal afternoon."

THE TEXT-BOOK AS AN ELEMENT IN SCIENCE TEACHING.

PROF. GILBERT B. MORRISON.

When a child first awakens to consciousness he finds himself surrounded by a world of wonders, a world of varied forms and forces of which he is himself a part. This has been the common experience of every intelligent child since man first inhabited the earth. The extent of the individual man's knowledge and understanding of the multitude of material objects—animate and inanimate—in their manifold relations to one another and to himself, fixes his real standing as a scientist, for science is the knowledge of the facts of nature systematized as to their relation, agreement and difference, cause, etc. The extent of any individual's understanding depends on the age in which he lived, the native ability possessed by him, and the character of the influences surrounding his life.

The process of systematizing the world's knowledge has been long and laborious, each age and generation contributing its mite. The first condition of any material progress from age to age lies in the record—the recorded mental experience—of each age for the use of the next. Without such recorded experience no progress could be made, for then each child would begin where his father began, instead of where his father left off. The ideas of all who try to interpret the appearances of nature, without first availing themselves of ancestral experience as recorded in books, are about as crude and primitive as are the earliest records of the ancients. To properly direct the young in their efforts to understand, interpret, and utilize the facts, phenomena and forces of nature is the business of the teacher of science. Now, the chief means in this process is the text book. I am aware that lately much has been said and written intended to lead to a conclusion directly opposite regarding text-books and to make them secondary and unimportant factors in science teaching. Because text-books are often misused in the hands of teachers who know not how to use them—teachers who teach by pages and not by subjects, stuffing the memory and neglecting the reason—many have been erroneously led into the belief that text-books are the next thing to useless, and that pupils should "study nature for themselves." This pedagogic re-action that has led well meaning and enthusiastic teachers to the extreme of condemning the principal means of scientific teaching, has resulted from the prevalent abuse of this means by not connecting it sufficiently with the objects it treats, to make it understood and, therefore, of any value. One of these extremes is about as censurable as the other. One leads to encyclopædic, stultified cramming, the other to diffusion and dissipation. A text-book in any department of science is supposed to treat its subject in a general way—to state clearly the main principles of the science, preceding each by a sufficient number of examples and facts to

make these principles understood. I only refer to those text-books prepared by authors who know how to teach, and not to those whose arrangement violates the proper method of presentation. The mistake has been not in teaching the text-book too much but in not teaching it enough—in not teaching it properly. In the short time given to the study of each branch of science in our schools that course should be pursued which will best prepare the student to continue the studies thus begun or to engage in the activities of a business life. What will best prepare the student to continue the study thus begun? Some say take him into the woods and let him "study nature for himself." Others will quote Prof. Agassiz, who is reported to have said to some pupils who came to him for instruction: "I hope you have not brought any books, I don't want you to read."

A child who "studies nature for himself," with no definite plan marked out for him upon which he can concentrate his powers of thought, will see and notice as many things of minor importance and of no relevancy to the subject at hand, as things that will lead to unification and generalization. He perhaps collects together a lot of trash, takes it home and calls it his cabinet. He reaps a harvest of bugs and butterflies, and thrusts pins through their sensitive bodies in the name of science. His mental impressions and conceptions will be made wholly on appearances. His classifications will be made with reference more to appearances then to organic structure and tissue, for it took ages of accumulated experience to reach such a method of classification; and our little "investigator" is denied this because it is "second-handed" and may not be true. He perhaps acquires a mighty zeal in his work. It is easy and a good deal like play to wander in the woods and "collect specimens." He goes on till his collections swell to formidable proportions; and if he does all this without the aid of a text-book he will be as much of a scientist as Adam got to be.

If there is anything for which we have reason to be thankful it is that we live in an age that makes science possible; but nothing like true science is possible with a boy who pursues the above described course. I would not be understood as depreciating the value of cabinets and historical collections. On the contrary, my appreciation of them and their true place in teaching, I shall try to make apparent in the course of this discussion. How then shall the pupil in the short time allotted at school get the best possible start? I shall precede the answer to this question by a quotation from Wm. T. Harris, who is probably the profoundest thinker in pedagogics in this country: "The business of a school," says this thinker, "is to enable the pupil to help himself to the accumulated experience of the race as found in books." Why did he not say: as found in nature? Simply because, although the principles of scientific truth have existed since man began his existence here, it has taken the combined mental activity of the race thousands of years to find them out. Whatever method then will best enable the pupil to appropriate understandingly what is now the common property of mankind is the true method. Some one has said "that the business of the teacher is to teach the pupil how to read." When this is understood in its full meaning it contains all there is in teaching. There are more pupils leave school who do not know

how to read than there are who can not conjugate a Greek verb, or identify the geological formation on which they stand. I mean by reading simply *getting thought from the printed page.*

Now, teachers who are so enthusiastic on teaching nature instead of books, say the children do not understand the books, and then make that a reason for quitting them. As tersely stated by Herbert Spencer: "They by their method induce stupidity, and then straightway make that stupidity a reason for their method." They would say: "Come, children, it takes a 'conscious effort' to understand this author, let us take a romp in the woods and discover these principles for ourselves." They romp, see many pretty things, collect some shining shells, kill some pretty birds and come back refreshed and invigorated in spirits, but perhaps no better able to understand the "horrid book" than before. They will in this way learn many interesting things and profit by the exercise, but still be unable to read—to get thought from the book. They leave school without this ability, and though they may be sharp observers, their observations will be superficial, for they are not deepened by the thoughts of great scientists whose language is the text-book which they have never learned to appropriate because it required a "conscious effort." Any possession, mental or material, that does not cost effort is not worth the having. It is effort and *conscious* effort that makes men. The tendency to relieve pupils of effort and the neglect of that kind of training which teaches them *how* to make it, is weakening the efficiency of our schools.

I will now try to make myself understood regarding what I believe to be the proper use of the text-book. I do not mean that its use is measured by the number of facts it contains, nor that the chief object in mastering it lies in the bare knowledge it imparts; but that its mastery implies the ability to *read*—to interpret recorded thought. The mere facts memorized from a text-book with no understanding of the principles they teach are of course worse than useless; and their incumbrance on the mind is even less beneficial than an aimless ramble in the woods; and it is this use, or rather misuse, of text-books that has resulted in the re-action represented by the misguided advocates of no text-books. But how shall the text-book be understood? How shall the teacher make it an efficient means in scientific pursuit? How shall he make it a stimulator and not a deadener? A complete answer to these questions would embody the definition of a true teacher. Whatever is required beyond the pupil's own resources to enable him to understand the subject at hand must be furnished by the teacher. The value of the teacher lies in seeing just what and how much is needed, and how to apply it. An occasional pupil will be most benefited by receiving no aid at all. He studies the subject from the book, thinks about it, verifies when practicable by experiment, criticises if thought necessary, observes its bearing on the experiences of life, masters the entire thought of the author, and if his taste leads him to be a specialist, having thus appropriated ancestral experience, he is able then to pursue the subject independently and add his might to scientific progress. But the majority of pupils will need some aid from the teacher to enable them to read the

scientific record—to study the text-book profitably. The pupil's eye is the index to his thought, and the teacher knows when to supply aid; and a few apt questions will serve to determine the kind needed.

Now, the more the teacher's resources are aided by illustrative apparatus and properly arranged cabinets, the better. Objective representation for what cannot otherwise be conceived should always be at hand, and much depends on their judicious use. Should collections, objects, apparatus and illustrations fail to penetrate the understanding of pupils exceptionally dull, the teacher is then, to the extent of his time, justified in "taking to the woods," with the sole object of clearing up the dark point, returning when this is accomplished in order to avoid the mental distraction of noticing too many things at once. Pupils want more concentration and less diffusion. A continual and unnecessary interposition of objects may cultivate perception but it sacrifices imagination and reflection.

The extreme notion that pupils should be relieved from books in scientific study, is only a single phase of object-teaching, the perverted use of which is now foremost in the ranks of educational crazes. True objective-teaching is not here assailed, but only that perverted use of which it maintains that a thing can not be known unless the learner is subjected to bodily contact with it. The use of objects in teaching is to bring subjects of thought within the grasp of the imagination. When the time arrives in the pupil's mental evolution, that a subject can be clearly and accurately conceived without a material illustration, any intervention of the object consumes time and weakens the noblest faculties of mind. To know just when the object can profitably be dispensed with, is a vital element in teaching. The continual parade of objects whose properties are already well known to pupils is as disgusting to them as the absence of those they cannot understand is discouraging. There are good and well meaning teachers laboring under the delusion that a pupil cannot know a thing without having exercised his senses upon it. Let us see where this notion pursued to its ultimate consequences will lead us. Taking the single branch of zoölogy as an example, this theory would limit the knowledge of the naturalist to those animate forms which he could personally see, examine and dissect. If his knowledge of the animal kingdom by this means ever became considerable, he would have to spread himself even beyond the possibilities of a specialist in this one study.

Now the fashionable and senseless custom that justifies the mutilation by every student of science, of all forms of defenceless animal life that is available, would be amusing were it not for its barbarity. This foolish aping of the scientific specialist who is adding useful data to his special branch, by tyros in science who have not even learned the first principles of classification is, to say the least, an inexcusable and misguided zeal. In studying anatomy the pupil should have clear notions of the essential elements of animal structure. The nature of bone, tissue, fluids, and organs can be known by the close examination of a single animal taken as a type. If the modifications of these elements as found in other

animals cannot be understood by descriptions and drawings, then the work of scientists has been in vain. Let us carry this notion, that bodily contact is necessary to understanding, outside of the realm of abstract science, and see how it applies to economic science. Suppose an architect of Kansas City learns that another architect in Philadelphia has planned and erected in the latter city a house, complicated in structure and unique in design. Our Kansas City architect wishes to build one exactly like it. How is he to proceed? If it is true that nothing can be known till personally examined, he must journey to Philadelphia, see the building with his own eyes, travel all through it on his own legs, measure its every part with his own square, and work out all the architectural proportions with his own arithmetic. Now, who does not know that such a proceeding would be the last thing that a reputable architect would do? The design by the original architect, accompanied with necessary descriptions, would convey to the mind of our architect a perfect conception of the plan, size and necessary detail; and his "mind's eye" would see the house exactly as it stands—an image worth many times more to him than any formed by the protracted tramp first supposed.

What I have said is not intended to apply to specialists, who are laboriously and meritoriously collecting facts for future generalization. It is intended for those who are teaching classes promiscuously composed of pupils preparing for all avocations of life. Science ranks first, when properly studied, in its proportionate exercise of the presentative, representative and reflective powers of the mind; and any method that stimulates one of these powers to the extent of neglecting the others, should be avoided.

CORRESPONDENCE.

MINING OUTLOOK IN COLORADO FOR 1884.

DENVER, COLORADO, August 13, 1884.

EDITOR REVIEW:—There appears to be a very mistaken impression abroad as to the actual present status of the mining business in Colorado, arising probably from the fact that all heretofore connected with the mining business of the State has been produced through intense excitement, arising from new, and formerly unknown occurrences of ore-bodies yielding in a short period vast amounts of wealth.

To-day this is all changed, and mining men, as well as eastern investors, are awakening to the fact that the mining business is, and can be made legitimate; especially if the same care and attention are paid to the details as are given to any other class of business to make it a success.

At the present time the speculative part is from perfectly natural causes perfectly eliminated, which causes may be stated as the result of greater knowledge among men generally as to the requirements to make mining a success; partly to the re-action that always follows the "boom" or intense excitement of any business. I might also include among these causes the present low prices of metallic lead, (which I do not think will last much longer) also that during this past winter, 1883 and 1884, we had such general and very deep snows, that in most parts of the State it was impossible to work. Ere that cleared away came the "rich man's panic" in New York City, which sat down upon every uncompleted mining sale, as the proposed buyers did not know how long the trouble would last, and of course, as good business men, held the cash they had on hand, awaiting the results of the future. On the heels of this the melting snows caused such freshets that the railroads were washed out, and all means of transportation in some sections for the time were cut off.

Such facts, following so closely together, would certainly bring the one great industry of any State to bed rock, and so it is in Colorado.

It would never seem as if bottom had been reached in the latter part of July, and almost at once we hear of work being started universally throughout the State. The marketing of the ore produced, naturally sets money in circulation at once. Not only that, but I know that the very men who withdrew from closing purchases of mining property at the commencement of the panic, are now coming forward and taking those same properties, and paying the cash; in some instances paying more than the price of the previous agreement. Such places as Denver, Pueblo, and other cities of Colorado, will certainly begin to feel the re-action, or effect of all this for the better, within the next sixty days.

But if your readers will look about for facts, they will be astonished to find that the present yield of Leadville, in gold and silver, for the past six months is greater than for any six months at the same time of the year in her whole history! Again, so far this year, Gilpin, Clear Creek, and Boulder Counties show every evidence of surpassing any year's product in their whole history as mining counties, while the whole southern part of the State is now in condition, owing to developments, and means of transportation, to make a showing in statistics that will only be expressed by millions. There is no doubt but the change we have looked and hoped for has actually come, and we can with every confidence look forward to five years of uninterrupted prosperity, to be closed with a wilder excitement in the mining business than Colorado has yet seen; for when it comes this time, it will not be confined to any one locality or mining section, but be universal throughout the State.

Personally this part is regretted by the writer, as after the "boom" comes the re-action, and business must of course suffer, but human nature is human nature, and I do not see how I can help it.

Respectfully yours, JOHN K. HALLOWELL.

METEOROLOGY.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	July 20th to 30th.	Aug. 1st to 10th.	Aug. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	66.	51.	62.	59.7
Max	95.	80.	92.	89.0
Min. and Max	80.5	65.	77.	74.3
Range	29.	29.	30.	. .
TRI-DAILY OBSERVATIONS.				
7 a. m.	74 8	63.0	69.0	68.9
2 p. m.	86.3	71.9	80.8	79.7
9 p. m.	73.7	64.5	71.5	69.9
Mean	77.4	66.0	73.2	72.1
RELATIVE HUMIDITY.				
7 a. m.	.78	.75	.84	.79
2 p. m.	.63	.39	.57	.53
9 p. m.	.80	.75	.86	.80
Mean	.75	.63	.72	.71
PRESSURE AS OBSERVED.				
7 a. m.	28.978	29.167	29.031	29.055
2 p. m.	28.991	29.137	29.011	29.046
9 p. m.	28.901	29.176	29.006	29.028
Mean	28.993	29.160	29.016	29.043
MILES PER HOUR OF WIND.				
7 a. m.	. .	. .	. .	. .
2 p. m.	. .	. .	. .	. .
9 p. m.	. .	. .	. .	. .
Total miles	2878	2142	2675	7695
CLOUDING BY TENTHS.				
7 a. m.	3.3	2.7	7.0	4.3
2 p. m.	3.9	1.2	4.3	3.1
9 p. m.	3.2	1.2	5.5	3.3
RAIN.				
Inches	0.86	.00	3.46	4.32

While July was a warm, moist month, the last decade, which belongs to this report was somewhat less rainy than the earlier part, and this was followed by ten days, from the first of August, in which there was no rain except a sprinkle on the 2d. By this time the ground had become quite parched and fears were entertained lest the corn might suffer. A change, however, occurred on the 11th and in the next ten days eight were rainy and a total 3.46 in. of water fell.

As will be seen in the tabular summary the first decade of August was not only dry but cool. From the 4th to the 9th the temperature fell each day below 60°, and on the 4th and 7th it was 51°.

DIRECT AND INDIRECT BAROMETRIC WAVES.

C. A. SHAW, ERIE, PA.

The barometric disturbance which accompanied the volcanic eruption of the island of Krakatau August 27, 1883, seems to deserve and doubtless will receive exceptional consideration from meteorologists.

Briefly, the narrative is that early in the morning of this date there occurred a gigantic explosion, heard for a long distance, which tore the island apart, threw an immense fragment a distance of some seven miles, probably producing a new island, and started an immense tidal movement which is believed to have journeyed around the world four times. "While the tidal gauges have recorded their story the delicate fingers of the barometrical registers of the world have also borne uninfluenced testimony of a similar kind. The blow which hurled such a mass of matter into the air, which originated a hurricane there and caused the barometers in the neighborhood of the volcano to rise and fall with unparalleled rapidity, and a vessel, distant three hundred miles, to tremble, started an atmospheric wave also around the globe. It was first detected in the Kew registers, and the dates at which the atmospheric undulations passed various places on the earth's surface it has been able to fix in many cases."

"Two waves, one to the east and one to the west, started from Krakatau, *whose rate of progress has been found to be that of sound.*"

The point to which I wish to call attention is that contained in these last words, which I have italicized. It gives the first standard of measurement so far as I am aware, of the rate of speed that a barometric wave travels under normal conditions. Other observations have shown such variable speeds that we must conclude either that their method of progression, as well as of occasion, is decidedly different from normal waves of propulsion or else that it requires an exceptional size of such air-wave to accomplish a rate of progress which shall be uniform and comparable to a standard, as that of the movement of sound.

The barometer, it is said, rose and fell many tenths of an inch in a minute. The rapidity of oscillation is possibly in this case as important as the range, for it implies the power of the impulse to overcome the resisting medium in front and the vibratory action of the surrounding atmosphere in quickly seeking to restore its equilibrium.

Future comparison of meteoric registers will determine several important relations of a local and general character. For example, at that rate of speed it undoubtedly overtook and passed certain areas of atmospheric low and high barometer producing conflicts of a peculiarly interesting nature. Some places must have shown surprising barometric registering, though by the present detached method of making observations it is but by chance that records of the Signal Service at any station would show it. Self-registering instruments are needed.

Were the service under any other direction than that of military men, it

would be pleasing for a scientific inquirer to seek to trace this curious air-wave around the world. But if he should write to the chief office very little satisfaction could be obtained even if he gained permission to write himself personally to each of the observers asking for data. No doubt the weather-bureau is a splendid institution and if it don't hit the weather quite right at the place where the reader chances to be, yet other cities are more favored we will believe. Then it is educating a fine lot of men to be soldiers, and if they do not know much of meteorology that is no disadvantage since out of the service meteorology is not a thing any one can live by.

Scientific men are decided as to the true method of predicting the track of barometric depressions. An example like this of a real wave of unexceptional magnitude which left its mark so definitely that no natural variation could obscure it, is like a case where a natural philosopher has in his own hands an experiment which can prove or disprove a world-accepted theory. At present the best theories of meteorological action have not received the certain sanction of undoubted fact. Ferrel's analysis, mathematical and profound, prove just this, that if true only one man in a million can understand and apply it, only one man in a million be a capable meteorologist. Certainly no army officer. Decidedly no enlisted man qualified and honored that he allows himself to be absorbed by trifling details and never rises to the grasp of principles. In military code all things are equally criminal as betokening insubordination. A hole in the end of a glove, or an ink-spot on a form go down with equal merit of punishment as shooting a comrade or missing an observation.

But it would be cruel while General Hazen is hanging on to his position with toe-nails and eye-lashes to say anything derogatory of his service when every other foreign nation admits that the military organization is the only possible one for efficient action. And this will be shown when the book shortly to be published, upon this very volcanic air-wave shall be made public; materials for which are now being collected by one of the lieutenants detailed for that service. Parodying the old parody of "bring forth the cheese knife," we may cry "bring forth a natural barometric wave (east moving) that can make 18,000 miles in twenty-four hours," and prove that low barometers have any real existence at all.

BOOK NOTICES.

E OF LISZT: By Louis Nohl, translated from the German by Geo. P. Upton. 12mo., pp. 197. Jansen, McClurg & Co., Chicago, 1884. For sale by M. H. Dickinson, $1.25.

This is the fifth of the series of Biographies of Musicians published by this well-known house. The preceding volumes are the lives of Mozart, Beethoven, Haydn, and Wagner, all of which were well received by the public.

The present volume is rather an essay upon the personal and musical characteristics of Liszt than a biography of him. Dr. Nohl in this sketch seems to have been somewhat carried away by his enthusiastic admiration for the man, who also inspired the same feeling in all his friends and intimates. This feeling manifests itself even in the very preface of the book where the author speaks of his early youth "with its incomperchenoible virtuosity. It is the actual strangling of the serpents in the cradle, so utterly does this power defy every obstacle and difficulty in the revelation of its art." "And now the great man rises resplendent in the great artist, in strong contrast with a kindred genius, the great violinist Paganini in whom, so different from Liszt himself, the essential principle which lies at the very root of artistic creation, namely, the genius of humanity, was not apparent." "Still further, there appears in its wonderful versatility, his active sympathy with all the momentous intellectual questions of the time and of humanity." "Then follows the new epoch in art-development, the creation of the symphonic poem, growing as it were spontaneously out of his association with all that is comprised in poetry and life. Then comes the crown of all, the latest and grandest work he has accomplished, the renovation of church music." These are samples of the admiration and reverence expressed by the author for his subject all through the book. It is thoroughly readable and among musicians alone should have a wide circulation.

THE TRANSACTIONS OF THE ACADEMY OF SCIENCE OF ST. LOUIS, Vol. IV, No. 3. R. P. Studley & Co., printers, 1884, $2.00.

We find in this volume articles by Profs. G. Seyffarth, F. E. Nipher, A. V. Leonhard, G. C. Broadhead, G. Engelmann, and G. Hambach: also the journal of proceedings and a list of publications donated and received during the years 1881–84. It is well printed and admirably illustrated. On looking over the journal of proceedings it appears that from ten to twelve members is a full attendance, but the character of the articles show that those members are careful investigators and thorough students. The officers for 1884 are Dr. Geo. Engelmann, President, (since deceased); Vice-Presidents, James M. Leete and M. L. Gray; Corresponding Secretary, Prof. H. S. Pritchett; Recording Secretary, Prof. F. E. Nipher; Treasurer, Enno Sander; Librarian, G. Hambach.

NINTH ANNUAL REPORT OF THE RAILROAD COMMISSIONERS OF THE STATE OF MISSOURI, 1883. Octavo, pp. 291.

From this Report, for which we are indebted to Hon. Geo. C. Pratt, we learn that there are now eighty-five main and branch lines of railroad in the State of Missouri, operated by thirty nominally distinct organizations. Of these organizations fifteen actually separate companies operate from seven-tenths of a mile to eighty-one and three quarters each, amounting altogether to 346.82 miles. The other companies operate the remainder of the lines, amounting to 4,268.74 miles.

The gross transportation earnings inside the State amount to $28,754,335, equal to $6,343 per mile of road operated The total expenses amount to $18,126,911, equal to $3,996 per mile of road and 63 per cent of gross earnings. The net earnings amount to $10,627,424, equal to 2,347 per mile of road and 37 per cent of gross earnings. Some very important questions are discussed, from which we make an important extract in this issue. The report is illustrated with a very good map of the State showing all of its railroads.

POLITICS: By William W. Crane and Bernard Moses, Ph.D. 12mo., pp. 305. G. P. Putnam's Sons, New York, 1884. For sale by M. H. Dickinson, $1.

This work is intended by its authors, the latter named of whom is Professor of History and Political Economy in the University of California, as an introduction to the study of comparative constitutional law and will be found a very comprehensive and useful treatise. In it are discussed such topics as the Nation, the Sovereign, the organs of the Sovereign, the force of the Nation, local powers, instinct as a factor of political organization, the political heritage of the British colonies in America, early impulses to national unity in the British colonies, centrifugal and centripetal forces, the makers of constitutional law, the makers of administrative law, the bi-cameral system of the modern legislature, the initiative in legislation, distribution of powers, the conditions and tendency of normal political growth, the tendency of powers in Federal government, the tendency of power in the United States, the tendency of power in some European federations, political parties. All of these are handled in a learned and liberal spirit suited to the spirit of the present day, and the work would make an excellent text-book for the more advanced classes in our colleges, as well as a most useful and suggestive hand-book for all persons desirous of obtaining an accurate comprehension of the political (not partisan) status in the United States.

WHAT IS TO BE DONE? By Robert B. Dixon, M. D. 18mo., pp. 67. Lee & Shepard, Boston, 1884. For sale by M. H. Dickinson. 50c.

This little hand-book contains many valuable rules and suggestions for the government of parents in rearing their children and will be found of service under almost all conditions of youthful ailments. We find sections devoted to artificial feeding for infants and children, baths, broken bones, croup, diphtheria, scarlet-fever, teething, vaccination, worms, etc., with sensible directions for nursing and diet as well as judicious remedies for the various complaints.

OTHER PUBLICATIONS RECEIVED.

Catalogue of the State Agricultural College of Kansas, 1883–4, Geo. T. Fairchild, A. M., President. A Letter to Scientists and Inventors on the Science of

Justice and their rights of Perpetual Property in their Discoveries and Inventions, by Lysander Spooner, published by Cupples, Upham & Co., Boston, Mass. An Appeal to the People of the United States in behalf of the Great Statue, Liberty Enlightening the World, Wm. Evarts, President of Executive Committee, New York. The *American*, a magazine of Literature, Education and Science, W. J. Bell and W. C. Ransburg, Editors, Valparaiso, Illinois. The Transactions of the Academy of Science of St. Louis, Vol. 4, No. 3, price $2.00. Professional Papers of Signal Service, No. 13, Temperature of the Atmosphere and Earth's Surface, by Wm. Ferrel, Government Printing Office, Washington, D. C., 1884. The *Young Mineralogist and Antiquarian*, published monthly by G. H. Wise, Wheaton, Illinois, 75 cents per year, Vol. 1, No. 1. Johns Hopkins University Studies, Herbert B. Adams, Editor, Second Series VII. Institutional Beginnings in a Western State, by Jesse Macy, A. B., Baltimore, Md., July, 1884. Ayer & Sons' Manual, 24th Edition, October, 1883, Ayer's Standard Lists of Publications, Philadelphia, Penn.

SCIENTIFIC MISCELLANY.

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

TORNADO-PROOF ROOFING.—The object of this invention is to provide a secure and safe fastening tin and sheet-iron roofing.

To be used especially in sections of country that are subject to the ravages of high winds and tornadoes, and it consists in providing extra fastenings in the form of staples or hooks that are driven through the roofing at the joints thereof into the wood-sheeting and clinched or otherwise fastened upon the under side; this in addition to the usual fastening-anchors and nails.

Any desired number of the fastenings may be applied to a roof according to the nature of the surroundings, and the violence of the prevailing winds.

After the fastenings are attached, the openings through the sheets are securely closed with solder thereby keeping the roof perfectly water-tight. Messrs. Chas. E. Wagner and Henry Flynt, of Kansas City, are the inventors.

HANGING SLIDING-DOORS.—This invention relates to improvements in the manner of hanging and operating inside sliding-doors, and its objects are to dispense with the usual double tracks and lateral guiding-rollers for the top of the doors, and to provide improved means for keeping the door in a vertical line while in operation.

It consists in using two independent single piece hangers, having journaled

in their upper extremity, a track-wheel with a circular groove upon its circumference and having fixed in a similar manner beneath the wood track a plain-faced roller which is adapted to prevent any tendency of the door toward tipping and raising the other hanger from the track.

A metal track having a circular or convex head, and a flange, on one side is employed, and it is attached to the wood track by any approved means.

In operation an inside sliding-door is suspended from a single track, faced by a circular threaded track-plate and attached to the timbers of a building in the usual manner.

Under-rollers are journaled within the intermediate fork of the hangers and are adapted by contact with the under side of the said track to keep the door in a longitudinally vertical position.

Lateral movement of the hangers is prevented by means of the annular groove upon the face of the suspending wheels fitting over the convex head of the metal track before mentioned.

There are openings in the top of the door in which the pendant threaded-end of the hangers are fixed. These are suitably protected by metal plates, and by reason of a rectangular opening in the same, the hangers are prevented from turning therein.

The door is guided and held in a vertical position by means of a double roller guide-plate which is adapted to operate within a groove formed in the floor-end of the door, the said guide-rollers are attached to the floor in such a position that the two centres will be in line with the said groove, but the line of the centres may form an angle with the line of the groove, as in this manner the guide-rollers can be so adjusted to a groove that is larger than the diameter of a single roller, as to avert any room for loose rattling.

This rattling is a common defect in the usual method of guiding the lower end of sliding doors.

The hangers described possess the advantage of being easily applied, as there is no leveling of double tracks, and as the weight of the door is hung directly beneath the centre of the track, there is no side draft, as is the case when one side of a double track settles with the building. This invention was recently patented by Mr. Henry Fleming, of this city.

IMPROVED LABEL-CASE FOR DRUGGISTS.—There is provided, a cabinet of suitable capacity and of ornamental construction that is provided with small open-faced compartments in which the labels are placed and held with their upper edges inclined outward, by means of a spring follower.

The case is constructed of any suitable material, preferably wood, and is formed with a number of horizontal rows of compartments that are composed of a back and a top and bottom beveled at the front edge for guiding the upper edges of the label toward the front opening and a facing block that has a segment of its upper edge cut away so as to exhibit the labels that are contained in the compartment and pressed against the inclined inner-side of the face-block.

The described spring and follower when in use, tend to press the labels outwardly and upwardly so that their upper edges project quite or nearly out of the front opening. This improvement has been patented by Mr. Boyd Keith, of Kansas City.

LOST ARTS IN THE PATENT OFFICE.

W. R. KIRK.

It is not the intention to inquire into the lost arts or the obscure theories of the past, but rather to consider the practical relation of Patent Laws to those arts that have fallen into neglect and been abandoned by reason of the defects in these laws. That such laws offer great encouragement to the development of the arts needs no proof in the midst of the great changes that are taking place. It has been conclusively proven that nations which do not recognize property-right in inventions not only fail to bring to light the theories of their own inventors, but cannot successfully adopt the perfected improvement of other nations. A patent is a contract between the government and the individual in which the interest of the public is as much of an object as the personal rights of the inventor. The government stipulates before granting a patent that the applicant shall make a full and free description of the improvement, so that it will enable any one skilled in the arts to construct the same, and in consideration of this it guarantees to him the exclusive right for a limited time.

It is presumed that the assurance of absolute control for this stated time will be a sufficient incentive for him to overcome the mechanical difficulties and educate the public to a sense of its value. This is the object and the ordinary working of Patent Laws, but there are times when events do not flow in the channels marked out for them: it is this feature that will be considered. The ultimate gain it will confer upon society is the prime factor in granting patents, for if it was held that progress was fatal to society no maudlin sentiment of personal rights would justify such protection. If this view of the proposition be true, are there not times when the courts are bound to follow rules in direct opposition to it? In illustration of this: some one applies for a patent. It may be that he caught the idea from some antiquated relic or he may have reasoned it out from his own stand-point, but when he applies for a patent he is referred to some previous one or some other evidence that some one has discovered it, although it may never have been worked to a successful issue.

The law, while assuming that individual control was necessary to develop inventions, in the absence of the original inventor, decrees that they must be left to their own fate. The first inventor may have been in advance of his time or he might not have appreciated its value. In that event it is not credited to him. If the law was designed only to reward the original inventor it would have accomplished about all that could reasonably be expected of it, but are there not

many times when there are circumstances beyond the control of inventors which render it impossible for them to succeed? One would at first suppose all that was necessary to develop anything new would be to publish it to the world, then the practical man would comprehend its value, and speed him on his way to success; but the history of almost every valuable improvement can be offered as a striking illustration of the falsity of such a theory. Inventions that are now worth many millions went begging for purchasers a few years ago at a mere nominal price. If such inventions have to struggle for existence, is it not reasonable to suppose that all did not get over the dead point, consequently that there are many valuable ideas that are undeveloped and cannot be because they are common property, no one having any special interest in them. The present law is a safe and conservative one and is well calculated to protect the inventor if he is the original one. When the law was framed there was little cause of apprehension concerning lost ideas, as there was a limited assortment with which to distract public attention.

Any change recognizing this feature should be approached with great caution, as it would open a convenient way to the greatest injustice. In many cases it would be difficult to tell when an art had passed into this neglected state, for in some instances a few machines would be sufficient to supply all wants, but if there was any doubt, patents need not be issued. Questions of as much importance are constantly arising under the present law. It would probably be wise to allow a considerable lapse of time from first evidence, or when patents had been granted they certainly should be allowed to expire, although they are frequently bought with no intention of developing them. This happens when parties do not wish the trouble of a change and do not like to run the risk of competition. The tendencies of patentees to sit down, as it were, on their inventions was brought up in a late Congress as a plea to invade the exclusive right. The argument was set forward on the part of certain corporations which would be the first to avail themselves of such a privilege, but they could afford to part with this one when they had secured a greater advantage. It is evident that the right to be effective must be absolute throughout the term of the grant. The philosophy that would regulate one's business is closely associated with communism and makes all ventures uncertain, yet there seems to be no good reason why such theories may not again be revived when the patents expire, for it is certainly a perversion of the spirit and intent of the law.

Seeing with what adverse circumstances inventions labor in unfavorable times, private misfortunes, public lethargy, unmitigated selfishness, it is not surprising that some should fail of being developed. In case prior invention is the difficulty met with, the problem is frequently complicated from the fact that the idea is not only absolute but of foreign origin and may never before have been known in one's own country, yet the court is governed by the theory that the public has gained by the investigation and that the matter must still remain in obscurity or else take care of itself. Whatever may be said, the present Patent Law is a good one and all such changes are attended with danger, and if we view

the hostile action of the last Congress, the friends of progress will be thankful if they can keep it as it is. An eminent jurist introduced a Bill into Congress during the last term, providing that innocence should be a valid defense for the infringement of this the most intangible of all rights. It was also suggested that the infringer should remain in the undisturbed possession of the right if it was for his own use. They would have to pay the customary fee. This would be a very convenient arrangement for the corporations that were advancing it, for having established a communism of rights they would have little to fear from the average patentee. In nearly all the cases cited in support of these attacks, had the infringers been made to pay the damages, they would still have been benefited by their use. The number of hardships are marvelously few, when we consider what great changes have taken place in late years, and in many of these so-called hardships the infringer did not use the most ordinary precaution. Certainly there are but very few of them who have not received as much benefit as injury from modern improvement.

Just here it might be well to consider the great amount of trouble caused by a litigation that arises out of the common and best established law-rights. Yet these few exceptions are taken up and made the grounds for legislation that would compromise the whole system. Whatever may be said upon the question, the remedies they suggest have the merits of completeness, and should they become laws they could have but little more to ask.

THE TWILIGHT OF GREEK AND ROMAN SCULPTURE.

WILLIAM SHIELDS LISCOMB.

It seems surprising, not that so many works of ancient art have been destroyed, but that any at all have remained until the present day. Transported from place to place, shattered by accidents, overthrown by earthquakes, consumed by conflagrations, subject to the destructive malice of Macedonian and Roman emperors, exposed to the violence of wars, buried beneath falling walls; delivered to the axe of the inconoclast, the hammer of the mason, the kiln of the lime-maker, and the melting-furnace of the bronze-moulder; torn from their bases, trampled in the mire and filth of the streets, broken into fragments, and gradually overwhelmed and hidden from view beneath the earth, how slight was the chance that productions of the golden age of Athenian sculpture should ever meet the eyes of that far-off nineteenth century in which we have our being! With what reverence may we justly stand before a work which, surviving such vicissitudes, has traversed the vast reaches of bleak, barren centuries that lie between us and antiquity, to greet us with its matchless loveliness to-day! Perikles may have gazed upon it; Sokrates, Plato, Aristotle, and Zeno may have taught their disciples in its presence; Euripides and Sophokles may have paused in the composition of their stately lines to rest the eye and brain on the symmetry of its propor-

tions and the spotless purity of its marble; Herodotus may have recited his histories and Demosthenes have thundered his eloquence before it; Cicero may have turned aside from the delights of poetry and the comforts of philosophy to contemplate in it the evidence of a finer genius than his countrymen could ever hope to attain; Virgil, Horace, and Ovid may have found their perceptions of beauty elevated and made nobler by its influence; the glance of Paul may have wandered over it as he proclaimed to the people the mysteries of the new birth and the hope of the resurrection; Marcus Aurelius may have seen in it a reflection of that heavenly truth and harmony in which his lofty soul found consolation; and still to-day the connoisseur may dwell upon it with ever-increasing delight, and find the subtle sympathy of art lifting him closer and closer into communion with those master souls of the past,—

"The dead but sceptred sovereigns, who still rule
Our spirits from their urns."

—*August Atlantic.*

EDITORIAL NOTES.

At 2:05 on Sunday the 10th ult., a sharp earthquake shock was felt in New York, Pennsylvania, and the New England States. As the observatory of the United States Signal Service, in the Equitable building, New York, the time of the earthquake and its duration were noted. Assistant Observers R. E. Hinman and Mervine were at the time in the office, which is on the roof of the building, about 200 feet above the level of the street. The first intimation of the earthquake was a low, rumbling sound, like the mutterings of distant thunder. It was immediately followed by a shock, as that of a violent explosion, which caused the building to quiver, although it did not shake perceptibly. The rattling continued for about eight seconds, and was accompanied by the rumbling sound, which gradually died away. The first shock was felt at about 2:11. The effect of the jar was much more perceptible in houses of light structure. While the shock was felt strongly in the dwelling houses, it is somewhat singular that persons traveling on the elevated roads did not know of the occurrence until they were told of it by people getting in at the stations, and that the shock felt in the elevated stations was slight compared with that felt on the ground below. As far as can be ascertained the shock was entirely imperceptible on the water, and no wave such as usually accompanies the phenomena in the adjacent waters was here observed.

Among other favorable notices of the article on the "Sewerage of Kansas City," by Mr. G. W. Pearsons, in the August Review, we find the following in a personal letter from the celebrated engineer, G. E. Waring, Esq.: "I have read with great pleasure your article in the Kansas City Review. You put the thing in a nutshell, so far as K. C. is concerned, and, indeed, strike what is likely to be the general compromise for all larger cities, it is precisely this that they are proposing to do in Paris."

Subscribers to the Review *can be furnished through this office with all the best magazines of this Country and Europe, at a discount of from* 15 *to* 20 *per cent off the retail price.*

To any person remitting to us the annual subscription price of any three of the prominent literary or scientific magazines of the United States, we will promptly furnish the same, and the KANSAS CITY REVIEW, *besides, without additional cost, for one year.*

WE were much pleased on the 14th ult. to receive a visit from the well-known Quaker-shoemaker-astronomer of Spiceland, Indiana, Professor Wm. Dawson, whose articles have so frequently appeared in the REVIEW during the past five or six years.

THE Interior Department, the Patent Office and the Smithsonian Institution are preparing to make a very fine exhibit at the New Orleans Exposition this winter, also for those at Cincinnati and Louisville this fall. Several car loads have already been shipped and others are nearly ready.

THE Kansas State Historical Society has accepted an invitation to coöperate with the Kansas Old Settlers' Association in a celebration at Bismarck Grove, Lawrence, of the thirtieth anniversary of the settlement of Kansas. The celebration will take place on September 3, 1884. Hon. F. P. Baker, President of the Historical Society, will deliver an address on the subject of "The Uses and Value of Historical Societies." The meeting is intended to be a general gathering of the early settlers of Kansas, and of all interested in the stirring events of the period of early settlement. The Kansas Territorial ex-Governors, Denver and Stanton, General John A. Logan, and others from abroad, have accepted invitations to be present.

THE Catalogue of the Missouri State University for 1883-4 shows an attendance, in all the departments, of 573 from seventy-seven counties of Missouri and seventeen other States and Territories. The Academic course of study is very complete; it extends over six years and is adapted to the educational wants of the State. There is no preparatory department but each one of the associated schools provides instruction in its own line of work to meet the need arising out of the lack of an adequate supply of High Schools. The optional feature is given free play under certain restrictions. Students, male or female, are allowed to enter any classes for which, on examination, they are found qualified; but each student must have in hand a certain number of hours of study and recitation for each week. Certificates are given by the Faculty certifying to the amount of work done by any student, and standing in the same; but all Degrees, attested by the Diploma of the Curators, are given only on the completion in detail of prescribed courses. The reputation of the University, as comparing favorably with our best institutions, seems to have been earned by the honest hard work of its industrious faculty. The next session begins September 8, 1884.

SIR JOHN LUBBOCK, the banker, parliamentarian and scientist, who owes his chief fame to his wonderfully minute researches in entomology, has been compelled to forego his visit to Montreal to meet his fellow members of the Royal Society, by reason of a severe attack of the gout. His absence will be regretted equally by his admirers among the members of the American Association.

MR. E. R. KNOWLES, who has written several reliable articles for the REVIEW within the past three years, and who is now connected with the Providence *Journal*, after investigating the manifestations of Miss Lulu Hurst, is convinced that "her manifestations are all simply the exertion of muscular strength under certain most favorable conditions by a young lady of fine physical development, and exceedingly skillful in applying her strength, and in knowing how to avail herself of any possible contingency of position, weight, embarrassment, hesitation, or confusion afforded by those who test her power; and that, governed by the same conditions, any person of equal physical strength can produce exactly the same phenomena with no more apparent effort. These feats are entirely physical, and can be confounded

with the phenomena of etheropathic induction only by the same class of persons who are easily led to believe in spiritualism merely by the cabinet mysteries and other very skillful feats of clever operators."

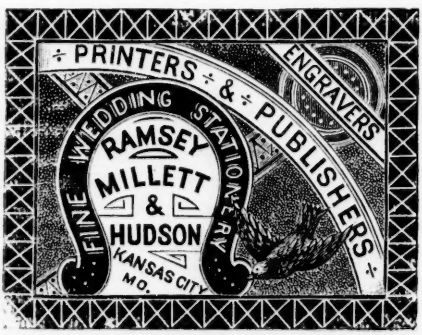
FEW people are aware of the important work now under way in Northern Minnesota, to guard against the dangers of high water and the inconveniences of low water in the Mississippi River. A number of lakes in that region are being connected into a reservoir system, which is to collect and feed water as it may be required. A full account of this great engineering work is promised, with illustrative diagrams, in the September *Harper's Monthly*.

CLUBBING RATES.

We can furnish subscribers to the KANSAS CITY REVIEW with any periodical published in this Country or Europe, at from 15 to 20 per cent below the regular subscription price.

For advertising rates address the Publisher,

THEO. S. CASE.



THE

YOUNG MINERALOGIST AND ANTIQUARIAN.

A MONTHLY JOURNAL in the interest of Amateur Collectors of Mineralogy and Mound-Builders' Relics. (**12 PAGES,** including cover.) Among its departments are: *Hints to Collectors; Correspondence; Inquiry Column; Exchange Column; Mineralogical Notes* (a Specialty), Etc., Etc. ADVERTISERS are offered an excellent medium through which to reach the best class of Collectors in this and Foreign Countries. A sworn Circulation of **5,000** each Month. Send for Estimates.

75 Cents per Year in Advance. Single Nos. 4 Cents.

N. B.—Publishers are referred to "RECENT PUBLICATONS." Juvenile and Scientific works receive careful notice.